CONSERVATION AND WILDLIFE MANAGEMENT IN AFRICA

The Proceedings of a Workshop Organized by the
U.S. Peace Corps at Kasungu National Park, Malawi

PEI-2: C76

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CONSERVATION AND WILDLIFE MANAGEMENT IN AFRICA

THE PROCEEDINGS OF A WORKSHOP ORGANIZED

BY THE U.S. PEACE CORPS

AT

KASUNGU NATIONAL PARK, MALAWI

OCTOBER 1984

EDITED BY

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INTRODUCTION

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PREFACE

THE ROLE OF THE PEACE CORPS VOLUNTEER
IN PARKS AND WILDLIFE MANAGEMENT

BY

GEORGE S. MAHAFFEY

AND

WILLIAM SUPERNAUGH

As background to these proceedings, a brief discussion of the Peace Corps Volunteer and his or her role in conservation, park and wildlife management and environmental education is presented.

Forest conservation, park planning and management, wildlife management and environmental education issues in the 1980s are, in one way or another, all related to the impact of increasing population pressure on a declining tropical forest resource.

Under the traditional system of shifting cultivation, the forested lands of the tropical regions provided an assured source of food, fodder and shelter for thousands of forest-dwelling farmers. In this century, increasing population pressures and spontaneous settlement have resulted in some 200 million people living and farming in formerly forested tropical zones. Land use patterns such as slash-and-burn (swidden) agriculture have decreased fallow cycles from about 20 years to, in many areas, less than three years. These short fallow periods are insufficient to allow restoration of soil fertility and, in many parts of Africa and Asia, a decline in annual food-crop yields has occurred, accompanied by accelerated destruction of remaining ecosystems.

As a result of the consumptive resource land practices such as fuelwood gathering, unrestricted wildlife harvesting, and slash-and-burn clearing, unprotected lands are continuously being converted, with the expected loss of terrestrial wildlife, aquatic and avian life, and their jungle, woodland and savannah habitats. Within this decade, for example, endangered species such as chimpanzees were being collected from remote areas of West Africa and Guinea and illicitly entering the black market. Routine military exercises in some parts of North Africa are considered as major contributors to the decline of some antelope populations. The capture and illegal exportation of parrots from throughout Latin America has seriously depleted populations of these endangered birds.

International recognition of the need to set aside and protect sufficient land to perpetuate fragmented ecosystems and their floral and faunal associations is gradually growing. National parks, wildlife and forest reserves are gaining in popularity worldwide but there has been special interest expressed by developing countries as they recognize this may be the last opportunity to preserve a remnant of the natural heritage of a nation.

Since 1961, in direct response to requests from more than 45 countries, Peace Corps Volunteers have worked with Ministry officials, village members and park staffs to develop park management plans, assess wildlife populations and conduct environmental education workshops. The Peace Corps' approach is unique. Before starting a two-year assignment overseas, Volunteers are appropriately trained as development workers for their target countries. They master cross-cultural and language skills to help them live and work successfully with their host country counterparts. They receive intense technical training in park planning and management, wildlife monitoring, conservation and/or environmental resource education techniques. They learn to approach conservation issues with sensitivity to cultural patterns that have developed over many years and must depend upon their own initiative and local resources in order to accomplish their objectives.

About 150 Peace Corps Volunteers are currently engaged in park, wildlife and environmental education projects or related natural resources activities in approximately 43 developing nations. Additional Volunteers will be requested each year as the growing awareness of the benefits from lands dedicated to the conservation of a nation's natural history are realized.

Peace Corps projects involving national parks often fall into the following categories:

PARK PLANNING--This may involve the preparation of a general management plan for a new national park. Parks which have been established for some time may require development concept plans, resource management action plans, concession management plans, the development of management objectives or the clarification of existing resource use policies.

PARK MANAGEMENT--Many national parks have not had the opportunity to provide technical operations-related training for their staff. Topics may range from supervisory skills training to trail and shelter construction techniques for the back country. Completed plans may now be ready to implement. There may be a need to provide new or additional interpretive facilities such as visitor contact stations, exhibits, waysides, nature trails, or maintenance facilities.

RESOURCE MANAGEMENT AND PROTECTION--Specific species related proposals may require the monitoring or manipulation of vegetation or wildlife in order to meet management objectives for a park. Some parks may lack an extensive data base and the preparation of resource maps and the acquisition of natural history inventories may be required.

PARK INTERPRETATION--Visitor use of national parks in developing nations may require elaborate transportation and housing systems or, visitors in some cases may not be permitted into parks at all. Most countries are interested in providing opportunities for national and foreign visitors to see and experience the natural and aesthetic resources of a park or preserve. This may require the development of multimedia informational presentations using available resources far from the technology of a Volunteer's home society.

Volunteers assigned to work in the wildlife, biology and management field may experience work of the following nature:

FAUNAL SURVEYS--Inventories of national parks, wildlife reserves and other protected areas may be incomplete. Ecological studies of endangered, threatened or economically important species are often needed. Life history studies and habitat surveys are frequently needed in order to prepare management plans.

WILDLIFE MANAGEMENT PLANS--There is growing emphasis on actively managing high interest wildlife species, especially those which may have received international attention. Populations may have been reduced below the critical number for genetic integrity or they may have been extirpated from their former range entirely. Efforts to reestablish or augment existing populations require extensive study and planning.

TRAINING--Volunteers may assist in the preparation of training materials or may be requested to train their counterparts in aspects of wildlife management for which they have a particular skill. Volunteers have taught wildlife management or biology in local school systems.

The field of environmental education offers many challenging areas in which to become involved:

PROBLEM ANALYSES--A Volunteer will soon encounter conservation practices which, in reality, are not beneficial to the perpetuation of sensitive natural resources. As these are the results of generations of accepted use, any attempts to alter these folkways must be accompanied by tact, sensitivity and viable alternatives. Wildlife, forest resource and soil conservation practices will require analysis and mitigation.

CURRICULA DEVELOPMENT--Environmental problems can be addressed through the development of conservation education programs for use in schools, or by public groups and agencies dealing with natural resources. This may involve the preparation of study topics to be introduced to children in the lower grades, added to a high school or university

general course of study,or as a specialized part of a teacher's program.

RESOURCE CONSERVATION--Work may involve the coordination of the efforts of various departments such as forestry, fisheries, parks, education and agriculture. Volunteers will work closely with related assignment areas such as parks and wildlife and may jointly produce environmental and natural resource information for use by park visitors, park managers and local schools.

To assure that the individual is fully prepared to work in the above mentioned categories, all prospective trainees receive language, cross-cultural and technical training prior to beginning their country-specific assignments. The training time period may range from six to eighteen weeks. The technical training component usually takes four to six weeks and is designed at various levels so as to accommodate academically trained and field trained Volunteers.

Given its basic philosophy of working at the community level to help poor people effect changes towards self-betterment, Peace Corps has and will continue to address critical development problems associated with the conservation of a nation's dwindling natural resources. This work can be demanding and frustrating. Volunteers need adaptability and commitment to working at the grassroots level in developing countries. Volunteers work within existing governmental structures. As a Peace Corps Volunteer in National Parks, Wildlife or Environmental Education, one deals with Ministry officials one day, park directors and supervisors the next and with area park wardens or a village member located within th park the day after that. You may find that people who are operating just above the subsistence level are not easily motivated to work on projects whose benefits are long-range. As important as your technical skills will be, the ability to organize and motivate others will often decide the success of your program. Undoubtedly, your progress will depend greatly on the relationships you forge and the trust you can inspire. You must be as open to learning as you are to teaching. You will need patience, determination, initiative and a sense of humor.

Peace Corps Volunteers in Parks, Wildlife and Environmental Education gain satisfaction not only by aiding the poor who are struggling with life in a tropical environment, but by making a significant contribution to the protection of natural resources on a global scale.

Different physical, social and cultural conditions among countries and regions do not allow a single solution to the problems associated with building a significant level of support for the protection of scarce ecological resources. The problem, however, either directly or indirectly affects everyone on earth. Peace Corps Volunteers, in collaboration with the people of their assigned countries, and with concerned international organizations, seek a means to preserve a precious resource. With all the difficulties inherent in such a task, Volunteers are given a rare opportunity to make a difference.

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FOREWORD

International recognition of the need to set aside and protect sufficient land to perpetuate fragmented ecosystems and their floral and faunal associations is growing. National Parks, Wildlife and Forest Reserves are gaining recognition worldwide. Developing countries recognize this may be their last opportunity to preserve a remnant of their nation's natural heritage.

Short-term and long-term problems associated with the degradation of natural resources call for immediate and sustained actions. Some of the tasks which lie ahead for the conservation community involve programming, coordinating, training, teaching, leveraging resources and working with local farmers, institutions, ministry officials and collaborating with private voluntary organizations (PVOs) and nongovernmental organizations (NGOs). Numerous programming strategies and technical actions are being applied by Peace Corps staff and Volunteers in an effort to reduce resource depletion.

It was intended that this workshop and related seminars and trainings scheduled for the future provide Peace Corps staff, Volunteers and Host Country park directors and wardens with improved planning and management principles.

We are hopeful this training and future workshops will continue to focus and sustain our conservation activities in park planning, park management, wildlife management, park interpretation, resource management and protection. It is our desire that by working and training together we can develop and sustain projects that promote the transfer of planning, management and technical knowledge, as well as self-reliance, to the people of the developing world.

Loret Miller Ruppe
Director, Peace Corps

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PROLOGUE

The Peace Corps, through the Forestry and Natural Resources Sector located in the Office of Training and Program Support (OTAPS), has sponsored a series of technical in-service trainings (ISTs) for Peace Corps Volunteers (PCVs) and their Host Country Colleagues. The objective of an IST is to provide PCVs and their Host Country Colleagues with additional specialized training in their field of work. The trainings are conducted during the Volunteer's first 6-12 months of service in-country and are designed around the specific expressed needs of tne potential participants themselves. The Malawi Wildlife and Parks Management Workshop was one in a series of many natural resource ISTs which have been conducted to date.

Peace Corps conducted a Wildlife and Parks Management Workshop in Niger in 1977 for the Africa region and another in 1983 in Paraguay which was attended by participants from six Latin American countries. The idea for a second African wildlife workshop originated from an inquiry by a Peace Corps National Parks Volunteer working in Niger. The Volunteer had heard of a similar agroforestry IST having taken place in Burkina Faso (then Upper Volta) and corresponded with the Forestry and Natural Resources Sector inquiring about the possibility of conducting an African wildlife workshop for Volunteers and their Host Country Colleagues.

Following up on the request, the Forestry and Natural Resources Sector conducted a needs assessment of the African Peace Corps countries to determine the topics pertinent to a workshop and the form of training needed. Ten countries responded to the assessment cable. A variety of topics were suggested. These ranged from fencing techniques to formulating management plans for the harvesting of ungulates, to how to handle the pressure on protected areas resulting from population increases and land shortages. After a thorough review of the many topics suggested, the staff selected the most frequently mentioned topics and arranged them in a logical sequence for an eight-day workshop. The principle theme of the workshop was Adaptive Management.

Once the objectives were established and participant numbers identified, a member of the Washington Peace Corps staff visited Botswana and Malawi in preparation of the workshop. The principle objectives of the trip were to select a training site, identify potential instructors and identify the resources needed or available, or both, for the workshop.

Based on its excellent park facilities, accommodations, accessibility and the enthusiasm of the Malawi Department of National Parks and Wildlife as well as that of the Malawi Peace Corps staff, Kasungu National Park in Malawi was chosen as the workshop location.

With the training site selected and participants identified, preparation of the final agenda was initiated. In developing this agenda, consideration was given to the Peace Corps Natural Resources Program Managers' request for a programming element to be included in the workshop. Several program managers stated that at the present time, they did not have any Volunteers working in parks and wildlife; however, the Host Country Ministries were requesting programming and training assistance from Peace

Corps in that area. Many of the program managers had little or no previous work experience in the field and wanted to participate to improve both their technical skills and their programming skills. Finally, invitations were extended to Peace Corps Volunteers, their Host Country Colleagues, the Peace Corps Natural Resources Program Managers and Host Country Ministry representatives. Having a diverse group of participants was very valuable and provided an interesting mix of information and insight.

Dr. Richard H.V. Bell, Senior Parks and Wildlife Officer (Research), of the Malawi Department of National Parks and Wildlife, was invited to Washington to work with the staff to prepare the agenda, finalize goals and objectives, and identify potential expert instructors to assist in the training workshop. Invitations were extended to, and accepted by, Mr. Ian Parker, a consultant based in Nairobi, who has over 25 years of experience in wildlife utilizations; Mr. Rowen Martin, Principal Ecologist, Department of National Parks, Zimbabwe; Mr. John Newby, Arid Land and Wildlife Ecologist, IUCN/WWF Representative to Niger with many years of experience in Sahelean Africa; and Ms. Sandra Price, President of the African Wildlife Foundation and the principal force behind the very successful Wildlife Clubs Program in Kenya. Dr. Bell served as the lead trainer for the workshop.

The training methodology utilized was a combination of theoretical classroom presentations with discussion; practical working sessions where the participants actually created valuable working tools to be used in their own parks; and field trips that corresponded to and complemented the lectures and practical sessions given in the classroom.

In conclusion, it was agreed that the workshop design and training methodology were very good and met the needs of the participants. It was unanimously expressed that conducting a workshop for Peace Corps Volunteers, Host Country Colleagues, Peace Corps Program Managers and Ministry Representatives was very valuable and that it allowed all to express their opinions from their vantage point, while at the same time hearing those of others and having constructive dialogue. Malawi proved to be an excellent choice as the training site. The Malawi Department of National Parks and Wildlife was a good model for others to see in operation.

ACKNOWLEDGEMENTS

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TRAINING PROGRAM GOALS AND OBJECTIVES

GOALS

● To provide an introduction to wildlife/wildlands planning methods and principals within a national development context, consistent with approaches increasingly utilized throughout Africa and the world.

● To bring together representatives of various groups/individuals involved with African wildlife conservation to discuss the overall structure of the wildlife/wildlands management profession and questions of conservation strategy.

● To provide guidelines and technical information for those directly involved in wildlife/wildlands management and applied research or carrying out various procedures in wildlife/wildlands management.

● To provide participants with an overview of the difficulties posed by population increases and agricultural land development and the resultant effect on wildlife habitats and protected areas.

● To provide guidelines on the utilization of wildlife resources and the problem of wildlife and human interaction outside of protected areas.

OBJECTIVES

● Working in groups, counterparts (PCVs and HCNs & APCDs and host country ministry officials) will gain an improved understanding of each other and thereby enhance their working relationship.

● Through lectures and field/site visits, participants will augment their knowledge and understanding of the environmental, economic and social implications of wildlife/wildlands management.

● Participants will view and discuss current methods of wildlife/wildlands management in their host/home countries and discuss the potential of improvement when combined with those from other participants.

● Analyze the environmental, economic and social ramifications that accompanies the application of sound management practices in achieving the stated conservation goals.

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AGENDA FOR
WILDLIFE/PARKS MANAGEMENT WORKSHOP

Kasungu National Park, Malawi
October 17 - 25, 1984

WEDNESDAY, OCTOBER 17

18:30	Arrival at Lifupa Lodge, Kasungu National Park
19:30	Welcome, Reception and Dinner

THURSDAY, OCTOBER 18

6:45 - 8:00	Breakfast
8:00 - 8:30	Introductions
8:30 - 9:45	Goals and Objectives, Agenda
9:45 - 10:00	Break
10:00 - 12:00	Conservation Goals and Discussion
12:00 - 13:30	Lunch
13:30 - 15:15	Principal Problems in Achieving Conservation Goals
15:15 - 15:30	Break
15:30 - 16:15	Description of Ecology of Kasungu National Park
16:15 - 18:00	Game Drive
19:00 - 20:00	Dinner

FRIDAY, OCTOBER 19

6:45 - 8:00	Breakfast
8:00 - 9:45	Identification of Conservation Priority
9:45 - 10:00	Break
10:00 - 12:00	Practicum
12:00 - 13:30	Lunch
13:30 - 15:30	Landscape Classification
15:30 - 15:45	Break

15:45 - 17:45	Landscape Classification as Functional Units of Management
19:00 - 20:00	Dinner
20:00 - 22:00	Country Presentations (Malawi, Niger)

SATURDAY, OCTOBER 20

6:45 - 8:00	Breakfast
8:00 - 12:00	Field work: Landscape classification Vegetation monitoring Response of woodlands to elephants
12:00 - 13:30	Lunch
13:30 - 15:30	Research Priorities
15:30 - 15:45	Break
15:45 - 17:45	Wildlife Management Model Development
19:00 - 20:00	Dinner
20:00 - 22:00	Country Presentations (Morocco, Burundi)

SUNDAY, OCTOBER 21

6:45 - 8:00	Breakfast
8:00 - 8:30	Wildlife/Human Interactions; Introduction
8:30 - 9:45	Wildlife Utilization
9:45 - 10:00	Break
10:00 - 12:00	Culling
12:00 - 13:30	Lunch
13:30 - 15:30	Legal/Illegal Use; Monitoring and Evaluation
15:30 - 15:45	Break
15:45 - 18:00	Methods of Monitoring Human Activity
19:00 - 20:00	Dinner
20:00 - 22:00	Country Presentations (Swaziland, Lesotho)

MONDAY, OCTOBER 22

6:45 - 8:00	Breakfast
8:00 - 18:00	Field Patrol: Objectives - navigation, recording of animal sightings, recording of human activity, report writing.
19:00	Dinner

TUESDAY, OCTOBER 23

6:45 - 8:00	Breakfast
8:00 - 9:45	Evaluation of Field Patrol
9:45 - 10:00	Break
10:00 - 12:00	Evaluation of Field Patrol (Continued)
12:00 - 13:30	Lunch
	FREE AFTERNOON
19:00 - 20:00	Dinner
20:00 - 22:00	Country Presentation (Burkina Faso, Liberia)

WEDNESDAY, OCTOBER 24

6:45 - 8:00	Breakfast
8:00 - 9:45	Public Relations and Education Techniques
9:45 - 10:00	Break
10:00 - 12:00	Public Opinion Polling
12:00 - 13:30	Lunch
13:30 - 15:15	Crop Protection; Methods and Evaluation
15:15 - 15:30	Break
15:30 - 18:00	Fence and Crop Protection (Field Trip)
19:00 - 20:00	Dinner
20:00 - 22:00	Country Presentations (Sierra Leone, Kenya)

THURSDAY, OCTOBER 25

6:45 - 8:00	Breakfast
8:00 - 9:45	International Funding and Support
9:45 - 10:00	Break
10:00 - 12:00	Master Plans, Work Programs, Estimates, Reports
12:00 - 13:30	Lunch
13:30 - 15:30	Role of Peace Corps Volunteers in Wildlife/Parks Management in Africa
15:30 - 15:45	Break
15:45 - 18:00	Conclusion and Evaluation
19:00	Closing Ceremony and Dinner

FRIDAY, OCTOBER 26

4:30	Depart for Lilongwe

LIST OF PARTICIPANTS

BURKINA FASO

Mark O'Donaghue   -   Peace Corps Volunteer, Game Ranching

Inyie Yaro   -   Director, National Parks, Govt. of Burkina Faso

BURUNDI

Peter Trenchard   -   Peace Corps Volunteer, Wildlife Management

KENYA

Godfrey Cherono   -   Peace Corps Staff, APCD/Programming

LESOTHO

Timothy Donnay   -   Peace Corps Volunteer, Wildlife Ecology

John Mosenye   -   Deputy Director, National Parks, Govt. of Lesotho

Tom Osborn   -   APCD/Agriculture & Rural Development

LIBERIA

Nicholas Bell   -   Peace Corps Volunteer, Wildlife Conservation & Education

Coker George   -   Peace Corps Staff, APCD/Agriculture & Rural Development

Nathaniel Penn   -   Peace Corps Volunteer, Entomology Technician

Joseph Toah   -   Park Warden, Government of Liberia

MALAWI

Bosman Chinzinga   -   Assoc. Parks & Wildlife Officer, Govt. of Malawi

John Mphande   -   Parks & Wildlife Officer, Govt. of Malawi

Tom McShane   -   Peace Corps Volunteer, Wildlands Management

Henry Nsanjama   -   Acting Chief Parks & Wildlife Officer, Govt. of Malawi

MALAWI (Cont'd)

Humphry Nzima — Parks & Wildlife Officer, Govt. of Malawi

Leonard Sefu — Parks & Wildlife Officer, Govt. of Malawi

MOROCCO

Youssef Alaoui — Chief, Hunting, Fishing & Protection of Nature, Govt. of Morocco

Mark Orlic — Peace Corps Staff, APCD/Agriculture & Fisheries

NIGER

M. Alio Hamidil — Director of Wildlife, Govt. of Niger

Kyla Monson — Peace Corps Volunteer, Range Conservation

Brian Shull — Peace Corps Volunteer, Wildlife Management

SIERRA LEONE

Sedu Turay — Peace Corps Staff, APCD/Education

SWAZILAND

Isiah L. Cindzi — Swazi Game Guard, Govt. of Swaziland

Suzy Ellis — Peace Corps Volunteer, Environmental Education

Edward Rowley — Peace Corps Staff, APCD/Agriculture & Rural Development

INSTRUCTORS

Richard H.V. Bell — Senior Parks & Wildlife Officer (R), Govt. of Malawi

Rowen B. Martin — Principal Ecologist, Govt. of Zimbabwe

John E. Newby — IUCN/WWF Representative, Niger

Ian Parker — Wildlife Management Consultant, Nairobi, Kenya

Sandra Price — Director of African Operations, African Wildlife Foundation, Nairobi, Kenya

INSTRUCTORS (Cont'd)

Yvonne Rogers
  Hubbard   -   Peace Corps Washington

Jacob Fillion   -   Peace Corps Washington

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CHAPTER 1

THE WORKSHOP THEME:

ADAPTIVE MANAGEMENT

BY

R.H.V. BELL

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The title of this workshop is "Conservation and Wildlife Management in Africa." This is a vast subject and, in order to reduce it to manageable proportions, we have introduced a theme. This theme has helped us select topics for discussion from the much wider range of possibilities, and has shaped the form of presentation of each topic.

The theme is "Adaptive Management."

The concept of Adaptive Management is simple and might equally well be described as common sense. In this concept, conservation and wildlife management are seen as being based on a set of disciplines, ecology, sociology and economics, which are exceedingly complex and poorly understood. Therefore, conservationists and wildlife managers characteristically operate in situations where the outcome on their actions is uncertain. Whenever we do something in these areas, we are never certain that the results will be as we expect, and we can be confident that there will be at least some unexpected side effects.

We argue, therefore, that the profession of wildlife management as a whole must be consciously structured to cater for these uncertainties, as well as for changes in value system, policy and technical capabilities. This means that the profession as a whole must be organized as a self-testing and self-evaluating system operating by negative feedback in relation to clearly defined objectives. In particular, each act of management or management procedure must be designed to serve as a test of the theory on which it is based. It must have a clearly defined objective, a definite procedure preferably including controls, a means of recording and reporting progress in relation to the objective, and a means of evaluating the procedure on the basis of which to decide whether to continue, improve or discontinue it as appropriate.

The topics selected for discussion at this workshop are those that assume priority in relation to the theme of Adaptive Management:

On Day 1, we have discussions of conservation goals and the principal problems in achieving those goals. In Adaptive Management, a clear definition of goals and objectives is an indispensible first step in any form of action.

On Day 2, we have an exercise in the identification of conservation priority. This provides a means of putting our goals into specific forms; given limited resources, where do we need to concentrate our efforts in order to get closest to our goals with the resources we have?

This is followed by a discussion of landscape classification. This is a means of breaking down our areas of interest into the functional units for the understanding and management of their resources. This assists in identifying conservation priority; subsequent acts of management will have effects specific to each landscape unit, and must be evaluated at this level.

Day 3 morning consists of a field demonstration of landscape classification. Day 3 afternoon is allocated to research priorities. The point emphasized here is that in Adaptive Management, research plays an

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integral role within the overall profession as the means of improving the ability of the profession to reach its goals. This requires organizational integration of the research branch with other branches of the profession; it also requires that research priority be given to topics of significance to management goals. In ecological terms this usually means soil-plant-herbivore-human interactions, but it also requires that research effort be directed to social and economic factors outside the strictly ecological sphere.

Day 4 is devoted to wildlife-human interactions, legal and illegal. This is a subject of overwhelming importance and could well make the subject of an entire workshop. The significance of this topic to Adaptive Management is that our assessment of wildlife-human interactions should define our goals and the methods of achieving them; appreciation of the significance of these interactions reemphasizes the importance of including social and economic factors in the feedback loops evaluating our conservation and management procedures. The importance of integrating conservation and wildlife management into the overall socio-economic development of each country may well emerge as a second major theme of this workshop.

Day 4 afternoon includes a session on law enforcement and methods of recording and evaluating illegal activity and law enforcement effort. Antipoaching is the primary management activity in many conservation areas. While Peace Corps Volunteers are not normally expected to become directly involved in such activities, we feel that it is important for them to be familiar with the situation and methods. The monitoring and evaluation of illegal activity and law enforcement also provides a textbook example of the feedback required in Adaptive Management, and in which PCVs can legitimately become involved. Finally, the monitoring method outlined provides a basis for monitoring legal use of wildlife resources by rural communities, should integrated utilization become widespread.

Day 5 is allocated to a field patrol with the game scouts of Kasungu National Park. This will allow the techniques discussed on the previous afternoon to be observed in practice.

Day 6 morning is allocated to writing up and evaluating the field patrol.

Day 7 morning is allocated to methods of influencing and monitoring public opinion. Here again the session is structured to illustrate an Adaptive Management procedure, with active educational techniques followed up by assessment, evaluation and feedback through public opinion polling.

Day 7 afternoon is allocated to crop protection, a major factor in influencing public opinion. Here again a session on crop protection methods is followed by one on assessment of damage and the efficacy of damage control techniques, again textbook Adaptive Management.

Day 8 morning starts with a session on funding and international support. This is less directly related to the theme but was seen as a priority by participants. This is followed by a discussion of master plans, estimates, work programs and progress reports. These we see as the

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means of controlling the business of the wildlife management profession in relation to its objectives as defined by policy. We see the concept of Adaptive Management as being embedded in the organization of each conservation agency and expressed in its master plans, financial projections, work programs and reports. We see wildlife legislation and the structure of each agency, including its recruitment and training, as the means by which each country's policy on conservation and wildlife management is put into practice by means of Adaptive Management.

Day 8 afternoon concludes the workshop with a discussion of the role of the Peace Corps in conservation and wildlife management in Africa, followed by an evaluation of the achievements of the workshop. This exercise is an example of Adaptive Management in action, through which the Peace Corps evaluates the workshop in order to improve the training provided by such workshops in future. In conclusion, Adaptive Management is simple in principle and involves little more than the application of common sense. It may be formalized into a set of eight basic steps as follows (cf., Bell 1980):

STEP 1: Consists of defining the alternative possible goals, that is the class of technically sound options (Bell 1983) and determining the means of achieving those goals;

STEP 2: Consists of choosing one set of goals and methods from the set of practicable options; goals and methods must be ordered in a hierarchy of relative priority;

STEP 3: Consists of carrying out research into the working of the whole system to be managed, including its ecological, social and economic aspects, in order find out how it works and how to manage it to achieve various alternative goals;

STEP 4: Consists of carrying out the chosen management procedures in such a way that they can be recorded, reported and evaluated;

STEP 5: Consists of monitoring the performance of the system in all relevant aspects, (ecological, social and economic) in response to each set of management procedures; such monitoring should be built into each procedure as an integral component;

STEP 6: Consists of reevaluating, on the basis of monitoring data, the theories on which the management procedures were based. In this sense, management procedures can be seen as a branch of research (MacNab 1983);

STEP 7: Consists of reevaluating the choice of goals on the basis of new theories of what is possible and of new value judgements as to what is desirable; and

STEP 8:   Consists of revising the overall management plan or of its component procedures in the light of experience from previous activities.   This may involve modifying or discontinuing certain management procedures if experience shows that they do not assist the agency in achieving its goals, or do so with unacceptable ecological, social or economic costs.

This system of Adaptive Management is a formalization of the time-honored method of trial and error.   It is idealistic in that it may require reeducation of all branches of many conservation agencies, but it is realistic in that it assumes the need to correct mistakes and modify judgements.

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SECTION 1

CONSERVATION GOALS
AND PRIORITIES

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CHAPTER 2

GOALS OF CONSERVATION AND WILDLIFE MANAGEMENT

BY

R.B. MARTIN

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The subject of goals for conservation has been admirably covered in *Guidelines for the Management of Large Mammals in African Conservation Areas* (CSIR 1983) and I find it difficult to add to or improve on the text (see Chapter 4). What I will do is comment afterwards on some priorities and shortcomings in our perceptions of goals.

Very briefly, the authors state the following:

Goals are set at various levels. The goals for global conservation can be taken from the World Conservation Strategy (Allen 1980).

- To maintain essential ecological processes and life support systems;

- To preserve genetic diversity; and

- To ensure sustainable utilization of species and ecosystems.

Further goals may then be defined at regional, national, departmental and specific protected area levels--right down to the level of an individual's role in the organization. It is important that the complete set of goals is consistent and compatible from the highest to the lowest level, or contradictions arise.

Moving to the level of the protected area, the following are some of the general goals listed:

a.   Conserve a representative sample of a biological region in a state relatively unaltered by man;

b.   Maintain areas or features essential for ecological processes;

c.   Maintain genetic diversity;

d.   Provide for environmental research, education and monitoring;

e.   Maintain and manage fishery and wildlife resources for sustainable production, whether of protein or for recreational activities;

f.   Protect outstanding landscapes for aesthetic and cultural purposes;

g.   Retain a maximum choice of land use options for the future; and

h.   Support and integrate social and economic activities in surrounding lands with land use practices in protected areas.

Following this, the authors give a simple flow chart system for examining which goals to choose for a given area, and then move on to consider a ranking system for the priority of goals. They discuss methods of stating goals from the national level to the policy document for an individual park, and conclude with a statement on the functioning of goals with time. While it is important to be able to alter goals as the need

arises, goals should also be sufficiently entrenched to ensure continuity of purpose in the long term. It is essential to monitor the degree to which goals are being realized from the standpoints of the public and the conservation agency.

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The above text might well be adopted as a starting point for the topic in hand: I would, however, like to draw attention to two points within it, and the two points are related.

The *afterthought* among the list of goals for protected areas is that of integrating them with the land use in surrounding areas. The *caveat* in the final paragraph is that goals for protected areas must satisfy the public and the needs of conservation (which, after all, are *public* needs as seen by the ecologist!)

Now, I can see certain of my colleagues present today saying, "it hasn't taken him long to get on his hobbyhorse!" And nothing is more tedious than the participant in a workshop who tries to divert the proceedings at the outset in a direction which the organizers never intended (as certain of my colleagues are inclined to do). This is not my intention. But it doesn't take any Pan-African resource survey to convince me that, at all levels, the goals of conservation are not being met. The Executive Director of UNEP states in his 1982 Annual Report:

> ". . . . why is there such a lingering feeling of dis-
> appointment about the year under review? Because deeds
> did not match words. There is a discrepancy bordering
> on the absurd between the serious concern registered by
> Governments at both [UN] Council sessions in 1982 about
> the state of the environment on the one hand, and the
> resources--both human and financial--devoted by those
> same Governments to the environment on the other. In
> 1972, the [UN] General Assembly established a voluntary
> fund 'to provide for additional financing for environ-
> mental programmes.' Yet the total contributions to
> that fund by the world community for the entire year of
> 1982 represented what the same community was spending
> in half an hour for military purposes. This fact,
> expressed in hard cash, drowns out the words of good
> intent expressed in decisions, resolutions and
> declarations aimed at protecting the environment."

The fact is our goals are not being met. As scientists we can easily satisfy ourselves that we are doing our best, and apportion blame to the other subspecies of human who is responsible for all the abuses of the environment. But are we really exercising our disciplines to best advantage? Bell (1983) has pointed out very clearly the role of a scientist within his discipline, and how this should be differentiated from his role as a concerned citizen. Every scientist should know when he is dealing with technical issues, and when he is exercising aesthetic preferences. While I agree fully, I don't accept that the scientist is constrained to move in a central groove down the middle of his disciplinary

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structure in science: there is nothing to stop him moving to the very edge of the boundaries which separate him from the adjacent science and, indeed, overlapping into its area. The exciting prospects that face us in the future are a cross-fertilization of scientific disciplines which may well generate better approaches to problems. However, this is diverging from the subject of goals and rightfully belongs in the session on research, where I will have a further opportunity to pursue the subject.

Perhaps we need a reappraisal of our whole conceptual framework of goals. We may believe that our own discipline is without bias and, because we belong to the religion of ecology, our moral standpoint is above question. I submit that this is not so. I fear the strong effects of our cultural and social backgrounds ill-prepare us for work in Africa. Perhaps our goals are the product of an elitist Western group and they are not only unsuited but *undesirable* for conservation in Africa. Lusigi (1981) has clearly stated the unacceptable nature of national parks planned by an alien culture, and Graham (1973) in the *Gardeners of Eden* points out very clearly the vast disservice the British conservation legacy has done to Africa.

It seems to me that in developing goals we all applaud the World Conservation Strategy, and yet as we progress from the broad general principles enshrined therein to defining goals for our individual protected areas, we bedevil the issue on a microscale by adopting all the worst restrictive practices originally introduced during a phase of colonial arrogance.

After all, what are the important issues a century from now? Firstly, there should be some topsoil that hasn't been washed into the sea. Secondly, there should be some vegetative cover to use the sunlight, soil and water for photosynthetic production, and thirdly, it would be pleasant if there were still some animal species around in viable reproducing populations.

Let's consider this. The World Conservation Strategy doesn't specify that all the flora and fauna has got to be contained (constrained) in a national park administered on colonial lines. Regarding the animals, I confess that I am not really a great purist on how they survive, as long as they survive. I don't care too much if, through management actions, subspecies A unhappily gets confused with subspecies B. [A few weeks ago, I was attacked by a British documentary film producer on the long-term implications of our domestication and translocation programs of wildlife in Zimbabwe. He couldn't see that there were now thriving wildlife populations in commercial farming areas which had been depopulated since the turn of the century: he immediately felt they should be in protected areas--even though that option no longer exists. This is not to say that there aren't sometimes very good reasons for preventing the interbreeding of subspecies. Hall-Martin (1984) reports the narrow shave where some genes of the Kenyan black rhino in Addo National Park very nearly got polluted by the local Southern African subspecies.]

Parker (1982) maintains that in the end, the only animals which will survive are those in protected areas. Perhaps he's right--but it's a fairly dismal prospect. Certainly it's not that serious if they disappear

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in large parts of Africa as long as they don't disappear everywhere at the same time--they are a renewable resource and you can always put them back. If I shock you with that laissez-faire statement, let me tell you about Bell (1984) who propounds a far more extreme solution for Africa. Roll on erosion, he says. He's one of these ecologists who bestrides the narrow world like a colossus--stands above Africa feeling through the soles of his feet the great geological spine of the continent, and observes over the millennia the gradual decomposition of the mountains into plains--the whole erosion process. I'm not quite sure when he says "roll on erosion" whether he means "lets lose the topsoil, precipitate the coming crisis, and perhaps after the crash we can make a new start" or whether he means "the more erosion, the more soil there will be in the plains, the more we will be able to grow for the burgeoning population, and hence the greater the breathing space." Either way, it's highly dangerous philosophy.

Caughley (1983) plumps for protected areas with minimal management where he "likes to watch ecological processes in action." Africa is a catastrophic continent. Animals live and die quickly. Brief interglacial blooms separate ice ages. Evolution in Africa is not a long gentle process of mutations appearing every thousand years or so with a clever adaptation to better use the habitat. More likely is a massive freeze, a massive drought or a grand massacre--and the odd individual survives, probably with worse genes than his siblings.

We have ignored the socio-economic issues in our land use planning, and the public which we once felt had to be satisfied with our goals for conservation is not the same public which determines the policy issues today. In the following I quote extensively from Spooner (1983). Many of the so-called ecological problems we are dealing with are to some extent a function of changes in the relationship between social groups. Ecology is a real science--but it has taken on a symbolic value. Its meaning is beginning to transcend its purely natural referents, and if we are unaware of this, then, we will be deceived about ecological reality. Ecology is now being used as a banner in a social conflict about rights to resources within western society. Its symbolization in the West has spread to the international arena, and there is a struggle to reorder the world economic order. The banner has been set up on the battlefields of desertification and tropical deforestation. All these ecological issues are socially embedded. The ecology is real; the issue is social; ecology has become a social issue through transformation to symbolic status. (Desertification, which is a far more immediate and specific word than ecology, has apparently failed to achieve such a value, since the response to the international call to combat it has been disappointing).

Maybe we will end up in Parker's last ditch stand protecting the parks against the masses. But it's mainly because we've chosen to set the battlefield in that position. Hobbesian philosophy states that humans are so flawed that society can only be made to work by rigorous imposition of order through institutions: Rousseau propounds that the individual is competent to produce unaided all the order that life requires. Perhaps the answer lies somewhere in between. In biology, we understand adaptation as a process involving genetics and natural selection: yet we still do not know how people adapt. We know that they do not always adapt, but we cannot tell when they will and when they won't.

Many of our conservation problems involving the man-environment relationship may best be solved by restating the positive aspects that could be used as basis for motivating change from within the social and cultural framework in a direction of increased ecological viability. At the moment, scientists are more concerned with the declining ratio of global resources to people than they are with the issue of rights of access to those resources and the competition for them.

I tend to hope that, given a restoration of rights, many rural communities could in fact make a reasonable job of resource management, and that such an approach would turn the tide in African conservation. If they can't, then, the battle is lost anyway because they will overrun the trenches surrounding national parks when resources are limiting.

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CHAPTER 3

GOALS FOR PROTECTED AREAS
MANAGEMENT OBJECTIVES FOR NATURE CONSERVATION

BY

KENTON MILLER AND GRAHAM CHILDE

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1. WHY CONSERVE?

Nature conservation is based on two philosophical principles. The first holds that all organisms, as well as man, have a right to exist. The second holds that living resources should be preserved for the benefit of present and future generations of mankind. These two principles are not necessarily in conflict. The right of all life to exist is central to many philosophies and religions of both eastern and western cultures. The need for living resources to be preserved for the benefit of man has recently been developed into the World Conservation Strategy (WCS) by the International Union for the Conservation of Nature and Natural Resources (IUCN) and the World Wildlife Fund (WWF). This document, produced through reference to over 800 scientists, administrators and managers worldwide, is a most thorough and widely applicable statement on the global role of conservation. It is supported and endorsed by the United Nations agencies, UNEP, UNESCO and FAO and a great many governments throughout the world. Consequently it forms a key philosophical basis for conservation, both in Africa and worldwide. It fully describes the wider goals of conservation and outlines strategies for achieving them.

A key message in the WCS is the need to establish and maintain protected areas within which species, communities and ecological processes can be preserved under conditions of minimal human influence. In many areas, such protection has led to a great increase in the numbers of certain large mammals and to changes in plant and animal communities. Decision makers and managers have then been faced with the dilemma of either killing the animals they intended to preserve, or of allowing ecological processes of change to proceed unhindered. It is in the context of this particular management problem that this handbook has been prepared.

2. WHAT ARE GOALS?

It is important to distinguish between the goal and the means by which it may be achieved. Culling elephants, for example, may be a means of protecting a particular plant community. The goal in this case is maintenance of a thriving plant community. It may equally well be achieved by putting up a fence or closing an artificial water point.

In the context of conservation it is useful to recognize that goals are set to apply at various levels. Global goals are stated in the following terms in the WCS:

a. To maintain essential ecological processes and life support systems;

b. To preserve genetic diversity; and

c. To ensure the sustainable utilization of species and ecosystems.

Local goals, such as those applying to a particular protected area are stated in more specific terms in law, policy documents and management plans. The various levels of goals may be viewed as nested subsets of the overall set of conservation goals, from the national level down to that of an individual's function or project. The importance of internal

consistency and compatibility of sets and subsets of goals cannot be over emphasized (Figure 1).

National goals and strategy: including international treaties, conventions, etc.; backed up by local regulation.

Departmental goals, set down in law and backed up by a departmental master plan (including administration, management and research).

Park goals (or function goals), e.g. research, visitor services, problem species), backed up by a park (or function) management plan.

FIGURE 1. A hierarchy of conservation goals at three levels. Additional, intermediate levels could be added catering for regional or district interests. More specific goals for sites or zones within a park, or particular projects within a function could be included at a finer scale (a and b). In practice there would be considerable overlap between goals.

3. WHAT GOALS ARE SUITABLE FOR PROTECTED AREAS?

Protected areas such as national parks, wildlife sanctuaries and forest reserves, provide the locations for people to achieve on-site conservation of renewable resources and maintain a part of their natural and cultural heritage. They also serve to protect plants and animals for future crop and livestock improvement and for the potential development of pharmaceutical products. They support recreation and education and provide opportunities to learn how ecosystems operate. In a regional context, protected areas can contribute to rural development and community welfare by safeguarding stream-flow, preventing erosion and providing limited employment. Additional goals may be tailored to specific local needs and moral obligations particularly to subsistence level societies.

Wild land and water areas are selected for protection because their natural resources are valuable for particular purposes. Goals are then set that provide direction for the management of the area selected.

Ideally, general goals for the management of a protected area are chosen as part of the planning process. Several "ideal" goals are suggested, drawn from existing parks around the world:

a. Conserve a representative sample of a biological region (province, biome or habitat) in a state relatively unaltered by modern man;

b. Maintain areas and features that are essential for ecological processes such as migrations, stream-flow and biological cycles;

c. Maintain genetic diversity and avoid the loss of species;

d. Provide facilities and opportunities for environmental education, research and monitoring;

e. Ensure the production of high quality freshwater with acceptable flow characteristics by means of watershed management;

f. Minimize the erosion and transport of soil, especially that which may adversely affect nature conservation and downstream investments in irrigation, fisheries, navigation, transportation, energy production and recreation;

g. Maintain and manage fishery and wildlife resources for sustainable production of protein and as the basis for industrial, sport and recreational activities;

h. Provide recreation opportunities for local and/or foreign visitors;

i. Protect and make available cultural, historic and archeological objects, structures and sites for public visitation, research and education purposes;

j.   Protect outstanding scenic landscapes for aesthetic and cultural purposes and provide enhanced settings for towns, highways, rivers or cultural and recreation sites;

k.   Retain a maximum choice of land use options for the future in respect of a particular area of land or water; and

l.   Support and, when appropriate, integrate economic and social activities in adjacent lands, with the land use practices of protected areas.

At the local level, these general goals are restated in a more detailed form to relate directly to biological systems, species and subspecies or other specific targets.

4.   HOW DO WE SELECT GOALS?

a.   Conflicting Goals:

Many of the goals listed above can be attained in a single area but some may conflict. For example, in the Umfolozi Game Reserve, Natal, the goals of white rhino preservation, and maintenance of species diversity can be pursued simultaneously. However, adding to these two goals the intent to maintain the reserve in a natural state free from overt management, clearly leads to conflict. In the case of such conflict, one goal must outweigh the others. Typically it is possible to pursue two or more goals in one area, but where conflicting goals occur, it may be possible to achieve both in different sectors of the protected area through zoning.

b.   Global, Regional and Local Goals:

In order to avoid conflict between the different goals of a reserve, it is useful to arrange them in an order of dominance. From a conservation point of view, a logical hierarchy follows the sequence from global (highest) through regional to local (lowest) importance. The flow diagram (Figure 2) illustrates the sequence of decisions in choosing goals. It goes without saying that it should be the target of every conservation agency to work towards a full and balanced array of goals that satisfy the conservation needs of its country and all its people.

(i)   To show how this flow diagram can be used, a few examples are given.

(1)   The mountain nyala inhabits an area in Ethiopia; the flow diagram shows the species to be important at the global level (because it is found only in Africa); at the intra-African level (only in Ethiopia); and locally because it is found in only one area.

(2) The southern white rhino is for the same reason important at the global and intra-African level (South Africa only) but less important at the local level because it occurs locally in several protected areas.

(3) The wildebeest is important globally as a valuable species and a dominant grazer of African grasslands. It is of less value at the intra-African and local levels for it is found in several countries and many national parks.

(ii) However:

(1) The Serengeti wildebeest migration as a phenomenon or process is important at all levels following the same reasoning as for mountain nyala.

(2) The nyala in Malawi is of global importance as an African antelope of limited distribution; it has limited intra-African importance because it occurs in protected areas in several countries but the Lengwe population is of national importance as it is the only population occurring in Malawi.

(iii) Following the selection of goals on conservation criteria, the manager, together with the policy maker, must also consider:

(1) Potential contribution to community welfare. To what extent do goals contribute positively or negatively to surrounding local communities? How can these contributions be more positive?

(2) Legislative backup. Are the goals compatible with present legislation? If not, either the goals or the legislation may have to be modified.

(3) Are there adequate natural resources, including land area, sufficient to allow the achievement of goals? Deficiencies here indicate that goals are unrealistic.

(4) Has the administrative system got the manpower, skills and executive capacity to achieve the goals? If not, then long-term planning must provide for training and expansion of these components.

c.   Ranking Goals According to Priority:

Various types of protected area have been established around the world to achieve combinations of these goals. These areas are known by a variety of names, such as national park, national monument, resource reserve, wildlife refuge or sanctuary, hunting area, game farm, botanic or nature reserve and wilderness area. There are many more. Conservation agencies are generally responsible for several such types of area. To clarify the relationship between possible goals and the full array of protected area categories for which an agency has responsibility, the following exercise is recommended.

A matrix should be constructed with all the possible objectives of the agency (such as those on page __) listed on the vertical axis, and all the possible categories of protected area it controls or has any sort of responsibility for (such as an advisory responsibility), listed on the horizontal axis. The cells of the matrix may then be filled in, in the style of Miller (1983), according to the relative importance of each objective for each type of protected area. An example of a grading system to indicate the dominance or priority ranking of objectives is as follows:

   (i)   Objective dominates the entire area.

   (ii)   Objective dominates only part of the area through zoning.

   (iii)   Objective shares dominance with other objectives over all or part of the area.

   (iv)   Objective may be secondary to other objectives over all or part of the area.

   (v)   Objective is not applicable.

There are many ways of grading the dominance order of objectives, but whatever system is used, this form of analysis will show up similarities and differences in how protected areas should be managed. It is particularly useful for policy makers and those involved in planning.

DOES THE PARK HAVE ANY FEATURE OF GLOBAL IMPORTANCE?

1. CONSIDER GOALS SET OUT IN WORLD CONSERVATION STRATEGY.
2. DOES THE PARK CONTAIN ANY GLOBALLY UNIQUE FEATURE, COMMUNITY, POPULATION OR PROCESS?
3. CONSULT IUCN

NO — YES →

This feature, be it landscape, ecosystem process, community, or population must be the priority goal, e.g., Victoria Falls, the Serengeti wildebeest migration, mountain nyala in Ethiopia.

⊛

DOES THE PARK HAVE ANY FEATURE OF SPECIAL INTRA-AFRICAN IMPORTANCE?

1. DOES IT CONTAIN A FEATURE, PROCESS, COMMUNITY, OR POPULATION POORLY REPRESENTED ELSEWHERE IN AFRICA?

2. CONSULT IUCN AND OTHER COUNTRIES IN AFRICA.

NO — YES →

This feature or population indicates the dominant goal, e.g., the swamp system in the Okavango, the Lammergeyer in the Drakensberg.

⊛

DOES THE PARK HAVE ANY FEATURE OF LOCAL IMPORTANCE?

1. DOES IT CONTAIN A FEATURE, PROCESS, COMMUNITY, OR POPULATION OF SPECIAL IMPORTANCE WITHIN THE COUNTRY?
2. CONSIDER SURROUNDING FORMS OF PRESENT AND FUTURE LAND USE.
3. CONSIDER SOCIO-ECONOMIC ISSUES

NO — YES →

This feature must have goal priority, e.g. the _Acacia xanthophloea_ forest in Ngorongoro crater and the nyala in Lengwe National Park.

⊛ Consider secondary objectives including those for resource allocation and human use options. Arrange in priority order.

Consider utilization options and more specific local goals. Finally, consider alternative forms of land use.

Periodicially reevaluate goals

Figure 2. A decision sequence for selecting goals. The sequence follows an ecological order of dominance - the ecosystem - the biotic community, the population, and finally the species.

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TABLE 1

An example of part of a matrix to analyze the priority relationships between objectives and types of protected area (adapted from Miller, 1983). Numbers refer to priority rankings listed above.

Objective	National Park	Wilderness Area	Hunting Reserve	Recreation Area
Preserve genetic resources	1	4	3	4
Provide for visitor recreation	2 or 3	3	1 or 2	1
Production of protein or profit	5	5	1	4 or 5

5.   HOW SHOULD GOALS BE STATED?

The goals defined for any protected area of conservation function should be formalized by means of specific policy directives. These should indicate to staff at all levels the administrative, planning, research and management options available. Once formalized, such a directive represents a logical delegation of authority, from the legislature down through the policy making level to the field manager. It should be a clearly stated unambiguous document that is compulsory reading for all staff down to field manager level and should be freely available to interested members of the public. It is after all their park, so not only should they be informed of its objectives, but they must be given effective means to question them and the ways in which they are implemented.

The determination of conservation goals follows a series of logical steps. Goals may be defined and a suitable site then selected where those may best be achieved, as for example, when a particular ecological process (i.e., the influence of variable rainfall on mammal population dynamics) is to be maintained by means of a protected area. More commonly, a protected area may already exist and it is a question of determining appropriate goals for it, taking into account global, continental, national and local priorities.

Consultation and discussion within the agency and, when appropriate, with representatives of the public, will lead to the refinement of goals. These may then be included in policy documents which are submitted for ratification to higher authority.   The level at which this should be carried out will depend on the nature of the goal, the structure of the agency and the extent to which authority has been delegated to it and within it.

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CHAPTER 4

PROBLEMS IN ACHIEVING CONSERVATION GOALS

BY

R.H.V. BELL

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1.   INTRODUCTION--THE CONFLICT OF VALUE SYSTEMS:

The previous session has outlined the range of conservation goals at global, national and local levels. For most conservation agencies, the principal goals are as follows:

PRIMARY GOALS:

a.   Prevention of extinction of selected species of animals and plants;

b.   Maintenance of selected biological communities within specified limits to change; and

c.   Preservation of selected landscapes and features of particular aesthetic beauty, cultural significance and scientific interest.

SECONDARY GOALS:

a.   Preservation of catchments and water resources without prejudice to primary goals;

b.   Consumptive and nonconsumptive uses without prejudice to primary goals; and

c.   Generation of revenue without prejudice to primary goals.

Essentially, these goals mean that we, as conservationists, intend to maintain certain physical, biological and aesthetic components of our environments within predetermined limits (cf., Bell 1983). Usually we are most aware of the lower limits beyond which we do not wish components to fall. For example, we do not wish large mammal populations to drop below the genetically viable limits of, say, 500 individuals (Frankel and Soule 1981). However, we should also be aware that in most cases upper limits exist, even if we do not usually have to worry about them as we do with human or elephant densities. In the case of deleterious environmental processes such as erosion rates, by contrast, we are usually more concerned about the upper limits, although an erosion rate of zero is not necessarily always desirable.

The existence of a problem in achieving our conservation goals means that there is a difference between the state of things as they are and the state of things as we, conservationists, would like them to be. In other words, the current state of our environment conflicts with our value system as conservationists.

The first question to ask, therefore, when we encounter a problem in achieving our conservation goals is: Does the problem lie in our conservation goals themselves? Are we setting our sights too high? Is our conservationist value system out of line with physical and biological realities or with the overall value system of the society concerned?

There are many situations where such is the case. A well-documented example is the history of the royal forests in Britain, detailed by Trench (1967); these forests were established by the invading Norman kings in the 11th century, but were steadily eroded by indigenous Anglo-Saxons in spite of merciless legislation and enforcement, until by the 16th century, they had largely disappeared. This example, as Alastair Graham argued in "The Gardeners of Eden" (1973), has parallels in contemporary Africa where foreign conservation values, or at least the methods of achieving them, have been imposed from the top down on resident societies.

More specific examples can be found. The listing of the leopard and the Nile crocodile on CITES Appendix I, virtually eliminating the international trade in their products, is widely regarded in Africa, even by conservation authorities, as an erroneous value judgement. Both species are widespread, numerous, and often constitute dangerous hazards to life and property. If the listings are not changed, they may endanger the credibility of CITES, as a whole, in the countries that harbor these species.

Similarly, many conservation agencies have attempted to obtain protected area status for land which they cannot in fact protect. An example is Lengwe National Park in Malawi, which in 1975 was extended from 104 km^2 to 887 km^2. The extension contained considerable numbers of people with their cultivation. In spite of lengthy negotiations and some unilateral law enforcement, many of the people are still within the park extension and the conflict of value systems is sharply defined.

2.   THE STRATEGY OF THE ATTAINABLE:

I am not arguing here that certain conservation goals are invalid; I argue (Bell 1983) that conservation goals are based on personal aesthetic value judgements that are not open to logical discussion. Some receive widespread acceptance, others do not.

What I do say is that certain conservation goals are impractical and unattainable. What we need to do is to map out a strategy of the attainable. This means working out a clear system of priorities, identifying the obstacles and costs in achieving those priority goals, and taking steps to minimize the conflict of value systems while compromising our priority goals as little as possible.

This will not be easy, and each of us who tries it can expect his share of flak from those whose value systems with respect to priorities and bargaining chips differ from ours. Put simply, such a strategy recognizes that we cannot conserve everything. It may contain the following types of compromise:

Firstly, we should explicitly recognize that certain types of wildlife are either harmful and should be controlled, or are insignificant and need not be managed. (See Chapter 33 on Wildlife Management Policy.)

Secondly, we should recognize that it is impracticable to confer protected area status on certain areas of land because to do so conflicts with stronger human interests of other types. For example, Clarke and Bell

(in prep) argue that protected areas established in areas of high human population density contain built-in problems, are expensive to maintain in financial and political terms and should only be attempted in cases of appropriately high conservation priority. The same is true of areas containing highly prized natural resources, such as minerals, fertile soils or fish.

Thirdly, we should recognize that the biologically desirable feature of large size for protected areas may be undesirable politically. Clarke (1981) has argued that the optimal size for protected areas may be relatively small, because small size minimizes the potential conflict of value systems and may help to ensure the long-term survival of the protected area.

Finally, we should recognize that in certain circumstances, full protected area status with no direct participation and use by local residents is inappropriate. The idea of integration of conservation areas into local rural economies is currently gaining wide acceptance over Africa, although in few areas has it yet been put into practice. This idea will be discussed in later sessions. Suffice it to say now that one important component of the strategy of the attainable is to soften our goals as to what is acceptable in protected areas and to emphasize negotiation and participation with local communities.

3.   NONHUMAN PROBLEMS IN ACHIEVING CONSERVATION GOALS:

Bearing in mind now that conservation goals are not objective yardsticks against which to evaluate our environments, we can go on to look at specific types of problems commonly encountered in achieving conservation goals.

First it is useful to separate out those problems which, given a particular set of goals, are not specifically human in origin. Unequivocal examples of this type are not easy to find, but one may consider the following headings:

a.   Changes in landform, erosion rates, and water levels caused by geomorphological processes;

b.   Ecological changes caused by changes in climate; and

c.   Ecological changes caused by ecological processes such as plant-herbivore interactions.

Let us take, as an example, the case of the effect of climate change on the sahelian zone. Whether the current changes are exaggerated by land use practices is not relevant to this argument, since major biotic shifts caused by climate have occurred in the past (Grove 1967) prior to significant human influences and will undoubtedly occur again. The problem envisaged is that, as a result of climatic shifts, the biotic communities requiring protection, such as the Sahelian community with addax and scimitar-horned oryx, may shift beyond the boundaries of the conservation areas designed to protect them. In such cases, there seem to be two main options for preserving those communities or at least their member species:

one is to attempt to establish further protected areas along the gradient of likely environmental change; the other is to maintain the community or its member species in situ (or elsewhere) by more or less artificial means (i.e., fencing, irrigation, captivity) until environmental conditions improve.

Changes caused by ecological processes differ from those due to geomorphological and climatic processes in that they are potentially capable of being controlled. Examples are provided by the plant-herbivore interactions leading to habitat changes commonly seen with elephants, hippo and smaller ungulates in Africa; these can, in principle, be controlled by culling. The question of whether or not to cull in such cases has been the subject of prolonged debate; this debate revolves around the definition of the goals for the areas in question. Those who define the goals in such a way as to accommodate wide trajectories in ecological processes (Sinclair 1983, Caughley 1983) tend to be opposed to culling; those who define goals in terms of a relatively narrow set of limits to permissible change (Pienaar 1983), tend to favor culling.

In these cases, we see that part of the problem in achieving our conservation goals may lie in the definition of goals themselves, or at least in our not being sufficiently clear as to their relative priority. In the case of the Sahel, climatic change may force us ultimately to abandon preservation of communities in favor of artificial maintenance of their constituent species, pending reconstitution under more favorable climatic conditions. In the case of ecological processes, we may solve the problem either by stretching the permissible limits to change to accommodate anything short of extinction of significant species, or by stretching our conception of a protected area to include management practices such as culling. The argument concerns the definition of goals rather than biological realities (Bell 1983).

4. HUMAN PROBLEMS IN ACHIEVING CONSERVATION GOALS:

We can now go on to discuss the more pervasive class of problems in achieving conservation goals, those that are human in origin.

Nonhuman agencies apart, the basic problem in maintaining our environments within limits acceptable to conservationists is the increase in use and modification of natural resources by humans, as a result, firstly, of the human population increase, and secondly, of the increased use of resources per head following technological development. This problem is clearly recognized by all conservation agencies and is a fundamental premise of IUCN's World Conservation Strategy.

Putting the problem in concrete terms relevant to conservation in Africa, Ian Parker (1984) has documented in detail the relationship between human and elephant densities over this continent. He has shown that as the biomass of humans and their domesticants increases, the biomass of elephants declines according to a curve determined by the resource base defined by rainfall and geomorphology. He argues that a given resource base can support a particular biomass, and that human biomass increases only at the expense of elephant (and other wildlife) biomass. He shows that elephants are liable to extinction in areas with human densities above

200 people/km^2, unless protected areas are created for them. We may take Parker's picture as the basis of a generalized model for the relationship between humans and wildlife resources in Africa.

We, as conservationists, argue that it is in the long-term interests of communities to develop means of self-regulation to population growth and resource use before regulation is forced on us by the limits imposed by the environment. These long-term communal aims, of course, immediately conflict with the short-term and individual aims within communities.

We here encounter a basic problem in theoretical biology, the question of how self-regulating mechanisms have evolved genetically; this has been the subject of prolonged debate, and is no easier to explain than it is to inculcate self-regulatory behavior in societies. It is no accident that the sociobiologist's view (i.e., Dawkins 1976) that all apparently self-regulatory behavior is, in fact, based on some direct regard to the individual or his offspring is politically unattractive to liberals and conservationists.

Here then, we have the central problem in achieving conservation goals: conservation goals refer to long-term and communal interests in the identification of which the individual has not always participated; these interests conflict with the short-term individual interests with which each person is directly identified.

This strategic problem can be seen to pervade the main areas in which we encounter tactical problems in achieving conservation goals.

a. The problem of land: As Parker (1984) has emphasized, many forms of human development are incompatible with many types of wildlife community or their member species (except in captivity). Preservation of these communities requires land, often of high quality, in which human uses have to be limited. Here, as noted earlier, we are brought into a direct conflict of values which can only be resolved in the terms of the strategy of attainability.

b. The problem of use of wildlife resources: Here we have two types of problem: firstly, the general problem of use of wildlife resources at nonsustainable rates leading to depletion below economic carrying capacities (cf., Caughley 1979 and Chapter 12) and possibly to extinction; and secondly the problem of legal or illegal use in protected areas or of protected species leading to depletion below levels (i.e., ecological carrying capacity--Chapter 12) set for noneconomic reasons. Here it is often as much the act of use itself that is unacceptable to conservationists, as the amount of use. In both cases we have a straightforward conflict between presumed long-term communal benefits and direct short-term individual benefits.

c. The problem of adverse public attitudes towards wildlife, protected areas and conservation in general: attitudes of the various sectors of the public towards conservation are not easy to assess. This question will be discussed in Chapter 30, but it

is safe to say that public attitudes frequently appear negative or neutral, particularly among rural residents close to protected areas and government officials. The reasons are that rural residents see wildlife as directly threatening to their life and welfare, while others see in protection of land and its wildlife resources, lost opportunities for economic gain, outweighing the relatively intangible long-term communal benefits of conservation.

d. The problem of modification of protected areas by infrastructure development: the problem here is that, in order to make concessions to economic interests, protected areas are frequently developed to the extent that the infrastructure, (roads, buildings, etc.) conflicts with conservation goals. An example is Kruger National Park in South Africa with its windmills, tarmac roads, accommodation for 3000 tourists and heavy tourist traffic. Nonetheless, this tourist traffic pays for the running of the national park system and represents a pragmatic compromise.

e. The problem of manpower for conservation agencies: conservation agencies are usually short of funds; equally, by their very nature they are responsible for remote and undeveloped areas. For these reasons, conservation agency staff are often required to live and work in very difficult and unrewarding conditions, in isolated posts, poor housing, without access to medical facilities or schooling and on low wages. Their work is often arduous and dangerous. The field staff is the backbone of the conservation profession, the footsoldiers at the front of the conflict of value systems. Too often, however, they are also the forgotten men of conservation. Senior staff and amateurs may devote their services at below-market rates as vocational workers, but the principle is unsound. If conservation agencies are to maintain professional and effective establishments, their staffs must be offered adequate economic incentives and conditions of service that are competitive in the employment market (see Chapter 36).

f. The problem of funding: the problem of funding for conservation agencies is a fundamental one. It stems from the fact that conservation specifically rejects short-term economic gains as a primary motivation; generation of revenue is recognized as a goal only where it does not conflict with higher priority goals. Conservation may make money, but often it cannot and should not be expected to; if conservation is obliged to make a profit, its primary goals will be compromised and it will be no different from the economically motivated system of laissez-faire that it is intended to mitigate. For this reason, the Malawi Master Plan for National Parks and Wildlife Management includes in its statement of Malawi Government policy with respect to wildlife the following paragraph:

"The government recognizes that revenue
generated by the department may not cover the
expenditure required to meet the government's
objectives. The government is committed to
ensuring adequate funding for the department
so that it may achieve its conservation
objectives in a professional manner."

Conservation costs money as lost opportunity: for example, the
existence of Kasungu National Park preempts the production of a large area
of tobacco crop; it also preempts a significant harvest of meat, skin,
ivory and cash from its elephant population. In addition, conservation
incurs direct expenditure in the form of salaries, running costs, etc. It
is important to notice that a high proportion of the expenditure on
conservation is incurred as a direct consequence of the conflict of value
systems between conservation agencies and the public, that is, in law
enforcement and public relations. The more closely conservation activity
corresponds with the public's perceived requirements, the cheaper it is.

Conservation costs money in lost opportunity and direct expenditure.
How are we to cover these costs? The short answer is that, if society
wants conservation enough, it will pay for it, either directly in the form
of donations and utilization fees or indirectly in the form of taxes. John
Clarke (1983) has compared protected areas to museums, libraries and works
of art. Such institutions are repositories of objects of beauty and
interest which the public supports directly or indirectly of its own will.
I have argued (Bell 1983) that people play the economic role of consumers
(willing to pay) in relation to conservation, rather than producers
(expecting payment). If people are not willing to pay, conservation cannot
succeed.

5. CONCLUSION--A WORD OF OPTIMISM:

I have argued in this paper that conservation is based on a conflict
of value systems. If everyone was a conservationist, there would be no
need for conservation. The conflict is between aesthetic ideals as to what
environments are best for communities in the long term, and physical and
biological processes or shorter term individual economic motives.

There are two main avenues towards resolution of these conflicts: one
involves bringing our ideals more closely into line with physical,
biological or economic realities, at the cost of compromising our
conservation ideals; the other is to bring physical, biological and
economic events into line with our ideals with costs, in terms of
management, enforcement and public relations, corresponding to the degree
of the discrepancy between ideals and events.

On the human side, clearly the essential trend must be to reconcile
our conservation goals with the individual aspirations of the people
concerned by integration, negotiation and participation. This will be
difficult for many purist conservationists. However, there will remain a
central core of high priority conservation goals where little compromise is
possible in order to prevent extinction of major species and to maintain
our planet's life support systems; the northern white rhino, the mountain

gorilla, the montane forests, to name a few. These will be the central redoubts in our strategy of the attainable, towards which we will be ready to fall back through prepared positions of decreasing compromise.

But I will conclude by saying that I am an optimist, particularly with regard to Africa. Reading the conservation literature, one might think that the situation is desperate. But is this really so? Nearly 4% of sub-saharan Africa is allocated to national parks or equivalent reserves, a proportion as high as that of any continent (Clarke 1981). Some of the poorest nations on earth have allocated over 10% of their land to protected areas, and in many African countries the area of protected land is steadily increasing. Several countries represented at this workshop are in the process of establishing conservation agencies and national parks. The current estimate for the African elephant is between 3/4 and 1 million (Western, personal communication) while the Serengeti wildebeest appear to have stabilized at about 1.5 million (Sinclair, personal communication). The financial allocation to conservation in Africa by the governments of its constituent states is of the order of $75 million per year (see Chapter 37). The price that Africa is prepared to pay for conservation in terms of damaged crops, lost opportunity and direct expenditure is very great.

Admittedly, there are serious losses; the rhino, the scimitar-horned oryx, the forests. But the overall situation suggests to me that the conflict of values is not as serious as we may sometimes think. To me, the only explanation is that the people of Africa are fundamentally committed to the conservation of the wildlife resources of this continent. There will be more losses, both of land and even of species, but the situation in Africa compares favorably with that in any part of the globe.

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CHAPTER 5

IDENTIFICATION OF CONSERVATION PRIORITY

BY

R.H.V. BELL AND R.B. MARTIN

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1. INTRODUCTION:

This paper is a report of an exercise in identification of conservation priority carried out at the Lifupa Workshop. It starts with an explanation of the background of the method used, it continues with a description of the workshop exercise, and it closes with a discussion of the method.

2. THE BACKGROUND:

A theme that has emerged clearly from the workshop so far is the need to establish and agree on a system of priorities in conservation. This is necessary, firstly, because of the great range of situations that require conservation effort in relation to the limited funds and resources available; secondly, because certain conservation objectives are incompatible and a method of establishing precedence is required; and thirdly, because it is useful to distinguish between topics that have priority in local as opposed to global terms.

The need to develop a systematic method of assessing conservation priority came into sharp focus at the meeting of the IUCN/WWF SSC Elephant and Rhino Specialist group at Wankie in July 1981 (cf., Cumming and Jackson 1984). Two very comprehensive Action Plans, one for elephant and one for rhino, were presented to the meeting, representing recommended priority expenditure of about US $10 million on priority conservation projects. However, only a fraction of this amount was in fact available, with the result that a further ordering of priorities was required.

At the Wankie meeting, the projects proposed in the Action Plans were divided into three types, those concerned with government and political action, those concerned with action on trade, and those concerned with field action. This discussion is concerned with identification of priority for field action.

A key paper by Ian Parker presented at the Wankie meeting provided a lead on how the problem of selecting priorities for conservation action might be tackled. The ideas contained in his paper were developed at the meeting into a scheme which was used to produce a generally agreed and ordered set of priority field projects for the conservation of rhino and elephant in Africa. The scheme made use of three categories of criteria:

a. Those relating to the biological importance of the population and area in question;

b. Those relating to the conservation status of the population and area; and

c. Those relating to a range of socio-economic factors impinging on the population and area.

Each project was given a numerical score in relation to a set of factors in each of these three categories. The scores from each of these categories could then be examined either separately or in relation to the others in a two or three dimensional plot. This type of plotting clarifies

the potential for shifting an area along any particular axis (i.e., into a higher range of conservation status) and the cost effectiveness of so doing.

The success of the conservation priority scoring system at the Wankie meeting prompted considerable discussion of this type of approach, particularly in Zimbabwe (cf., Cumming 1984), where the method has been developed and extended for national use at a June 1983 departmental workshop of the Department of National Parks and Wildlife Management (Cumming, Martin, Taylor and Craig, unpublished), and in Malawi (cf., Clarke and Bell, in prep.). At the June 1983 Zimbabwe departmental workshop, an additional category was added to those used at Wankie, as follows:

a.   Biological value;

b.   Conservation status;

c.   Socio-economic situation; and

d.   Landscape and amenity value.

In each of these categories, each area was scored in relation to a set of factors by means of a questionnaire. Each factor was given a weighting in relation to other factors in the same category. This system was then used to assess the relative priority of existing and proposed conservation areas in Zimbabwe.

3.   THE LIFUPA WORKSHOP EXERCISE:

At the Lifupa Workshop, the Zimbabwe system was used as the basis of a workshop exercise. The overall objective was to apply the system of assessing conservation priority to the conservation areas in the 10 countries represented in the workshop. This was done in three phases:

Firstly, participants were divided into four groups; each group was asked to take the questionnaire for one category of factors of the Zimbabwe system and modify it to suit the objective of using it on a continental scale. New or modified questionnaires were developed by working groups and modified again if necessary in plenary session.

Secondly, the representatives of each country then applied the new questionnaires to some or all of the conservation areas in their countries.

Thirdly, the scores were presented in tabular and graphic form in plenary session and the method and its results were subjected to general discussion.

4.   THE QUESTIONNAIRES:

The questionnaires developed at the workshop are shown below. The details of the scoring system will be explained in the next section.

CATEGORY A. BIOLOGICAL VALUE:

This category is intended to give an assessment of whether it is worth putting conservation effort into an area on the basis of purely biological considerations. This relates to the primary conservation objectives of preventing extinction and preserving examples of biological communities.

Factor A.1: Size of Area: MAXIMUM FACTOR SCORE   20

Rank	(i)	Less than 10 km^2	Rank Score	1
Rank	(ii)	10 - 100 km^2	Rank Score	2
Rank	(iii)	100 - 1000 km^2	Rank Score	3
Rank	(iv)	1000 - 10,000 km^2	Rank Score	4
Rank	(v)	Greater than 10,000 km^2	Rank Score	5

Factor A.2: Vegetation Diversity: MAXIMUM FACTOR SCORE   20

Rank	(i)	Single vegetation type	Rank Score	1
Rank	(ii)	At least two vegetation types, little interdigitation between types	Rank Score	2
Rank	(iii)	At least two vegetation types, with other types associated, and some interdigitation between types	Rank Score	3
Rank	(iv)	Two or more vegetation types, other subtypes and significant interdigitation between types	Rank Score	4
Rank	(v)	Three or more vegetation types with many subtypes	Rank Score	5

Factor A.3: Rare Plant Species: MAXIMUM FACTOR SCORE   10

Rank	(i)	No endemic species or threatened species	Rank Score	0
Rank	(ii)	No endemic species; at least one threatened species	Rank Score	0.9
Rank	(iii)	At least one endemic and one threatened species	Rank Score	1.8

| Rank | (iv) | A number of endemic or threatened species | Rank Score | 3.0 |

Factor A.4: Rare Animal Species: MAXIMUM FACTOR SCORE   10

Rank	(i)	No endemic species or threatened species	Rank Score	0
Rank	(ii)	No endemic species; at least one threatened	Rank Score	0.9
Rank	(iii)	At least one endemic and one threatened species	Rank Score	1.8
Rank	(iv)	A number of endemic or threatened species	Rank Score	3.0

Factor A.5: Geological Features: MAXIMUM FACTOR SCORE   10

Rank	(i)	Basement (low fertility)	Rank Score	0.9
Rank	(ii)	Mixed geology (medium fertility)	Rank Score	1.8
Rank	(iii)	Volcanics/marine sediments (high fertility)	Rank Score	3.0

Factor A.6: Ecosystem Type: MAXIMUM FACTOR SCORE   30

Rank	(i)	Woodland/Savanna	Rank Score	1
Rank	(ii)	Desert/Desert Steppe	Rank Score	2
Rank	(iii)	Grassland	Rank Score	3
Rank	(iv)	Lowland Evergreen Forest/Forest Savanna Mosaic	Rank Score	4
Rank	(v)	Swamp/Floodplains/Lakes	Rank Score	5
Rank	(vi)	Montane Evergreen Forest	Rank Score	6

CATEGORY B. LANDSCAPE AND AMENITY VALUE

This category is intended to give an assessment of the potential appeal of an area to visitors apart from its strictly biological value. The question being asked is, how many people would miss it if no attempt were made to conserve the area?

Factor B.1:   Special Geological Features: MAXIMUM FACTOR SCORE   10

Rank	(i)	Nothing of unusual interest	Rank Score	0
Rank	(ii)	Some exposure of rock/fossil/ geomorphological interest	Rank Score	1
Rank	(iii)	Good exposure of rock/fossil/ geomorphological interest	Rank Score	2
Rank	(iv)	Sole representative of geological feature in country	Rank Score	3
Rank	(v)	Sole representative of geological feature in world	Rank Score	4

Factor B.2:   Floristic Attractions: MAXIMUM FACTOR SCORE   10

Rank	(i)	Common vegetation with no special qualities	Rank Score	0
Rank	(ii)	Good representative of at least one vegetation type	Rank Score	1
Rank	(iii)	Good representatives of three or more vegetation types	Rank Score	2
Rank	(iv)	Vegetation stands with appreciated qualities such as tall shade trees or montane flora	Rank Score	3
Rank	(v)	Nationally unique vegetation stands	Rank Score	4
Rank	(vi)	Internationally unique vegetation stands	Rank Score	5

Factor B.3:   Faunal Attractions: MAXIMUM FACTOR SCORE   20

Rank	(i)	Insignificant populations of vertebrates	Rank Score	0
Rank	(ii)	Limited range of animals	Rank Score	1
Rank	(iii)	Impressive assemblage of wildlife	Rank Score	2
Rank	(iv)	Unique species population or spectacular aggregation of animals	Rank Score	3

Factor B.4:   Scenic Attractions: MAXIMUM FACTOR SCORE   20

Scenic types listed as follows: Grasslands, woodlands,
water, mountains.

Rank	(i)	One Type of landscape	Rank Score	1
Rank	(ii)	Two Types of landscape	Rank Score	2
Rank	(iii)	Three Types of landscape	Rank Score	3
Rank	(iv)	Four Types of landscape	Rank Score	4

Factor B.5:   Cultural Attractions (traditional, historical associations):   MAXIMUM FACTOR SCORE   10

Rank	(i)	No cultural value	Rank Score	0
Rank	(ii)	Some cultural importance to local inhabitants	Rank Score	1
Rank	(iii)	Regional historic value and interest	Rank Score	2
Rank	(iv)	High national historic interest or archaeologically important	Rank Score	3
Rank	(v)	High international cultural and/or historical significance	Rank Score	4

Factor B.6:   Recreational Attractions: MAXIMUM FACTOR SCORE   20

Rank	(i)	Very low visitor use	Rank Score	0
Rank	(ii)	Occasional visitor use for one recreational activity	Rank Score	1
Rank	(iii)	Moderate visitor use, limited range of activities	Rank Score	2
Rank	(iv)	High visitor use for a single recreational activity	Rank Score	3
Rank	(v)	High visitor use for a wide range of outdoor recreational activities	Rank Score	4

Factor B.7: Accessibility (communication, road condition, etc.): MAXIMUM FACTOR SCORE   **10**

Rank   (i)   Not easily accessible   Rank Score   0

Rank   (ii)   Far from urban areas   Rank Score   1

Rank   (iii)   Close to urban areas   Rank Score   2

CATEGORY C: SOCIO-ECONOMIC FACTORS

This category is intended to give an assessment of those socio-economic factors which would affect the ease and costs of conservation action in an area, bearing in mind that the more closely conservation action corresponds with short-term economic interests, the easier and cheaper it is.

Factor C.1: Conservation Awareness (national and local concern for a given area): MAXIMUM FACTOR SCORE   **20**

Rank   (i)   Low awareness at all levels   Rank Score   1

Rank   (ii)   Localized awareness (immediate park areas)   Rank Score   2

Rank   (iii)   Moderate awareness at government level only   Rank Score   3

Rank   (iv)   Moderate awareness at national level   Rank Score   4

Rank   (v)   Moderate awareness but improving (all levels)   Rank Score   5

Rank   (vi)   High government awareness but moderate concern   Rank Score   6

Rank   (vii)   High level of conservation awareness and commitment at a national and local level   Rank Score   7

Factor C.2: Conflicting Land Uses (vulnerability of the protected area to other forms of development): MAXIMUM FACTOR SCORE   **15**

Rank   (i)   High potential for mining or urban development   Rank Score   1

Rank   (ii)   High potential for irrigation   Rank Score   2

Rank   (iii)   Suitable for dryland cropping   Rank Score   3

Rank	(iv)	Suitable for extensive livestock subsistence agriculture or fishing or commercial forestry	Rank Score	4
Rank	(v)	Protected area status is most suitable form of land use	Rank Score	5

Factor C.3: National Conservation Importance and Investments: MAXIMUM FACTOR SCORE   **15**

Rank	(i)	Low importance and undeveloped	Rank Score	1
Rank	(ii)	Limited importance with little development	Rank Score	2
Rank	(iii)	Nationally important (catchments), no development	Rank Score	3
Rank	(iv)	Nationally important with moderate developments	Rank Score	4
Rank	(v)	Highest national importance with high use and capital development	Rank Score	5

Factor C.4: Economic Potential of Wildlife: MAXIMUM FACTOR SCORE 20

Rank	(i)	Little potential for tourism and cropping	Rank Score	1
Rank	(ii)	Moderate tourist or moderate cropping potential	Rank Score	2
Rank	(iii)	Moderate tourist and moderate cropping potential	Rank Score	3
Rank	(iv)	High tourist potential or high cropping potential	Rank Score	4
Rank	(v)	High tourist potential and high cropping potential	Rank Score	5

Factor C.5: International Involvement: MAXIMUM FACTOR SCORE   **15**

Rank	(i)	No outside involvement or interest	Rank Score	1
Rank	(ii)	Moderate interest by tourists and conservationists	Rank Score	2
Rank	(iii)	High tourist flow and/or internationally known	Rank Score	3

| Rank | (iv) | Potential World Heritage Site | Rank Score | 4 |
| Rank | (v) | Accepted World Heritage Site | Rank Score | 5 |

Factor C.6: Potential for Conservation-Related Development: MAXIMUM FACTOR SCORE   15

Rank	(i)	Hard edges and options in surrounding land largely foreclosed	Rank Score	1
Rank	(ii)	Hard edges but some options for integrating of land use	Rank Score	2
Rank	(iii)	Moderate edge effects and potential for developments	Rank Score	3
Rank	(iv)	No hard edges with good potential for integration of wildlife and rural development	Rank Score	4
Rank	(v)	Very high potential for integrated rural development	Rank Score	5

CATEGORY D: CONSERVATION STATUS

This category is intended to give an assessment of the current state of conservation activity and the requirements and probable costs of improving that status.

Factor D.1: Legal Status (United Nations listing): MAXIMUM FACTOR SCORE   8

Rank	(i)	No legal protection	Rank Score	0
Rank	(ii)	Legal protection with partial land use (reserves)	Rank Score	1
Rank	(iii)	Legal protection with no land use (parks)	Rank Score	2

Factor D.2: Historical Status: MAXIMUM FACTOR SCORE   8

Rank	(i)	Presently settled alienated land	Rank Score	0
Rank	(ii)	Previously settled and still regarded as homeland	Rank Score	1
Rank	(iii)	Unsettled but used	Rank Score	2
Rank	(iv)	Unsettled and unused	Rank Score	3

Rank	(v)	Unsettled with traditional support for conservation	Rank Score	4
Rank	(vi)	Traditionally protected or sacred area (hema)	Rank Score	5

Factor D.3: Manpower Resources: MAXIMUM FACTOR SCORE   **8**

Rank	(i)	No manpower, i.e., paper park	Rank Score	0
Rank	(ii)	Occasional patrol or visit	Rank Score	1
Rank	(iii)	Minimum staff	Rank Score	2
Rank	(iv)	Moderately staffed	Rank Score	3
Rank	(v)	Full complement	Rank Score	4

Factor D.4: Motivation and Technical Competence of the Staff: MAXIMUM FACTOR SCORE   **10**

Rank	(i)	No motivation or competence	Rank Score	0
Rank	(ii)	Technical competence, no motivation	Rank Score	1
Rank	(iii)	Motivated but lack technical competence	Rank Score	2
Rank	(iv)	Highly motivated, technically competent staff	Rank Score	3

Factor D.5: Funds and Equipment: MAXIMUM FACTOR SCORE   **8**

Rank	(i)	No funds or equipment	Rank Score	0
Rank	(ii)	Inadequate funding and equipment	Rank Score	1
Rank	(iii)	Moderate funding and equipment	Rank Score	2
Rank	(iv)	Funds and equipment not limiting	Rank Score	3

Factor D.6: Development and Planning: MAXIMUM FACTOR SCORE   **8**

Rank	(i)	Undeveloped, no access or base station	Rank Score	0
Rank	(ii)	Limited access and rudimentary plans	Rank Score	1
Rank	(iii)	Development constrained by climate, geology, topography, etc.	Rank Score	2

Rank	(iv)	Development irrespective of climate, geology, topography, etc.	Rank Score	3
Rank	(v)	Infrastructure developed but planning not fully implemented	Rank Score	4
Rank	(vi)	Full development, infrastructure and plan	Rank Score	5

Factor D.7: Research and Monitoring: MAXIMUM FACTOR SCORE   **8**

Rank	(i)	None	Rank Score	0
Rank	(ii)	Preliminary ecological survey	Rank Score	1
Rank	(iii)	Continuing ecological survey and basic monitoring	Rank Score	2
Rank	(iv)	Resident research unit	Rank Score	3
Rank	(v)	Fully developed research and monitoring unit	Rank Score	4

Factor D.8: Law Enforcement Capability: MAXIMUM FACTOR SCORE   **8**

Rank	(i)	None	Rank Score	0
Rank	(ii)	Occasional patrols	Rank Score	1
Rank	(iii)	Regular patrols, partially effective	Rank Score	2
Rank	(iv)	Capable, fully effective	Rank Score	3

Factor D.9: Identification of Illegal Activities: MAXIMUM FACTOR SCORE   **8**

Rank	(i)	Full range of illegal activities (define)	Rank Score	0
Rank	(ii)	Few illegal activities but endangering conservation goals	Rank Score	1
Rank	(iii)	Few illegal activities, not threatening	Rank Score	2
Rank	(iv)	Best situation	Rank Score	3

Factor D.10:   Poaching Threat: MAXIMUM FACTOR SCORE   8

Rank   (i)   Armed forces   Rank Score   0

Rank   (ii)   Park and local officials poaching   Rank Score   1

Rank (iii)   No poaching by officials but
                 commercial poaching   Rank Score   2

Rank   (iv)   Subsistence poaching   Rank Score   3

Rank   (v)   None   Rank Score   4

Factor D.11:   Land Pressure: MAXIMUM FACTOR SCORE   10

Rank   (i)   Rapidly expanding dense rural
                 population   Rank Score   0

Rank   (ii)   Expanding and moderately dense
                 rural population   Rank Score   1

Rank (iii)   Expanding population, largely
                 urbanized   Rank Score   2

Rank   (iv)   Sparse rural population   Rank Score   3

Rank   (v)   Stable urban and rural population   Rank Score   4

Factor D.12:   Civil Security: MAXIMUM FACTOR SCORE   8

Rank   (i)   Civil War   Rank Score   0

Rank   (ii)   War in neighboring country   Rank Score   1

Rank (iii)   Sporadic lawlessness   Rank Score   2

Rank   (iv)   Law and order fully maintained   Rank Score   3

5.   THE SCORING SYSTEM:

The purpose of the scoring system is not to imply an accurate quantitative assessment of the value of each area in relation to each factor. It is intended to provide a means of clarifying the subjective weighting attached to each category, each factor and each rank. Thus, the weightings at each level can be altered independently.

In the Wankie, Zimbabwe and Lifupa scoring systems, each category is given a maximum possible score of 100. This does not necessarily have to be done, and some might feel, for example, that the biological values category should be given a heavier maximum weighting of say, 200. Whether this is useful depends on the form of analysis.

Given the equal maximum scores for each category of 100, then the combined maximum scores for the factors in each category must add up to 100, for example, in the case of Category D, conservation status, the factors have the following maximum factor scores:

D.1	Legal status	Maximum Factor Score 8
D.2	Historical status	Maximum Factor Score 8
D.3	Manpower resources	Maximum Factor Score 8
D.4	Motivation and technical competence of staff	Maximum Factor Score 10
D.5	Funds and equipment	Maximum Factor Score 8
D.6	Development and planning	Maximum Factor Score 8
D.7	Research and monitoring	Maximum Factor Score 8
D.8	Law enforcement capability	Maximum Factor Score 8
D.9	Identification of illegal activities	Maximum Factor Score 8
D.10	Poaching threat	Maximum Factor Score 8
D.11	Land pressure	Maximum Factor Score 10
D.12	Civil security	Maximum Factor Score 8

T O T A L **MAXIMUM CATEGORY SCORE = 100**

The maximum factor scores may be modified at will according to the perceived weighting of each factor as long as the total adds up to 100. The values given here are those agreed on in plenary session at the Lifupa Workshop.

Now the actual score counted in each case for each factor is calculated as follows. Under each factor is a series of options in ranks (i) to, say, (vi). Against each rank is a Rank Score (R.S.). The factor score is calculated as follows:

$$\text{FACTOR SCORE} = \frac{\text{Maximum Factor Score X Selected Rank Score}}{\text{Largest Rank Score}}$$

Let us take as an example Category D, Conservation Status, Factor D.10, Poaching Threat. Here, the Maximum Factor Score is 8. The largest Rank Score is 4. However, the area we are scoring has no poaching by

officials but commercial poaching, i.e., rank (iii). Here, the Rank Score of the selected rank is 2. Thus, we have:

FACTOR SCORE   = Maximum Factor Score (8) X Selected Rank Score (2)
                           Largest Rank Score (4)

             = 8 X 2 = 4
               4

The use of this two-stage scoring system means that the weighting at the levels of factor and rank can be altered quickly and simply, but independently of each other.

6. RESULTS:

The results of the Lifupa workshop exercise are shown in Table 1, and are interpreted graphically in the scatter diagram, Figure 1.

In the scatter diagram, the Biological Value, Socio-Economic Status and Landscape and Amenity Value category scores are added together and lumped as a combined value called "Park Value." This combined value is then plotted against the conservation status score. The reasoning here is that, in the absence of computer facilities to carry out a multidimensional plot as was done at the Wankie meeting in 1981 (Cumming and Jackson 1984), the above combination was satisfactory in that the three combined categories represent the "given" features of the area, while the conservation status category represents an independent set of variables directly subject to control by conservationist action. This reasoning was accepted at the Lifupa workshop but will be discussed further in Section 8.

In Figure 1, the scatter diagram is divided into four quadrants, each of which combines a high or low Park Value with a high or low conservation status, the four combinations being as follows:

a.   High Park Value, High Conservation Status:

Nyika National Park, Malawi; Aire National Reserve, Niger; Park "W", Niger; Kibira National Park, Burundi scored with the surrounding Forest Reserves.

b.   High Park Value, Low Conservation Status:

Sapo National Park, Liberia; Malolotja National Park, Swaziland; Massa National Park, Morocco; Comoe-Leraba proposed National Park, Burkina Faso.

c.   Low Park Value, High Conservation Status:

Nazinga Experimental Game Ranch, Burkina Faso; Kasungu National Park, Malawi; Sehlaba Thebe National Park, Lesotho; Vwaza Marsh Game Reserve, Malawi.

FIGURE 1

SCATTER DIAGRAM OF SCORES FOR 14 CONSERVATION AREAS

1A: Kibira N.P. without forest reserve; Burundi
1B: Kibira N.P. with forest reserve; Burundi
2: Massa N.P.; Morocco
3: Malolotja N.P.; Swaziland
4: Kasungu N.P.; Malawi
5: Vwaza Marsh G.R.; Malawi
6: Nyika N.P.; Malawi
7: Nazinga G.R.; Burkina Faso
8: Comoe Leraba; Burkina Faso

9: Sapo N.P.; Liberia
10: Parc W.; Niger
11: Tamu G.R.; Niger
12: Aire N.R.; Niger
13: Sehlaba Thebe N.P.;
      Lesotho
14: Mwabvi G.R.; Malawi

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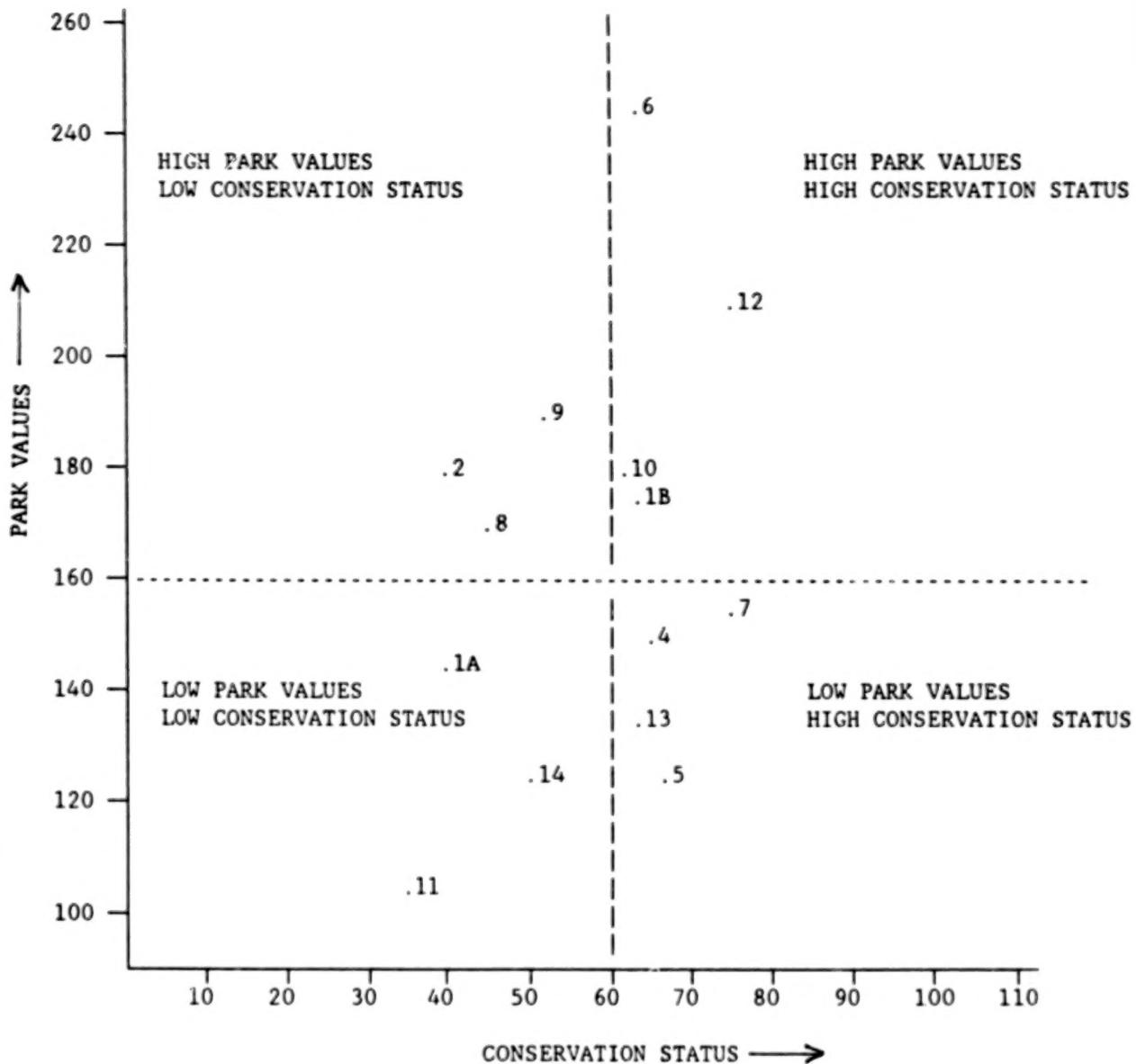
d.   **Low Park Value, Low Conservation Status:**

Kibira National Park, Burundi, scored without the surrounding Forest Reserve; Mwabvi Game Reserve, Malawi; Tamu Reserve, Niger.

7.   **DISCUSSION:**

Discussion of these results at the workshop started with general agreement that it should be emphasized that this method does not give an objective, quantitative evaluation of a conservation area. The scoring involves many subjective decisions and the detailed logic of the questionnaire needs to be thought out more carefully. However, the method does give a rational framework for ordering complex subjective evaluations. If two people, for example, carry out a scoring for the same areas and get different results, they can then look to see precisely where their evaluations differ. By doing so, they will clarify their thinking about the situation and thereby reach an acceptable compromise or defined grounds of disagreement.

Coming to specific points in the results, we may assume that the conservationist's objective is to move the points upwards as far as possible, preferably into the high park value-high conservation status quadrant. A case-by-case commentary helps to see how the scatter diagram can be used to clarify priority factors for attention and effort.

Kibira National Park in Burundi provides a good starting point. This contains a relatively small patch of montane forest, one of the few patches of unmodified woodland in the country. It contains chimpanzees and is an important catchment area. The park was evaluated in two ways. Firstly, it was scored by itself, when its score placed it in the low park value-low conservation status quadrant. Secondly, it was scored together with a surrounding forest reserve which includes exotic plantations and consumptive uses; this scoring places it in the high park value-high conservation status quadrant. Examination of the factor scores shows that this move is mainly due to the high level of awareness associated with the forest reserve as opposed to the park alone, and to the consequently much higher level of funding, staffing and equipment associated with the combined unit compared to the park alone. This case makes a very important general point, that where conservation can be functionally lined with other forms of land use, particularly forestry or agriculture, it has a much higher chance of support and funding. Another recent example is the funding of the Save The Rhino Trust in the Luangwa Valley, Zambia with $600,000 by Norwegian Aid (NORAD) through its linkage as part of a larger land use project.

TABLE 1

CONSERVATION PRIORITY SCORES FOR 13 CONSERVATION AREAS IN 8 COUNTRIES REPRESENTED AT LIFUPA WORKSHOP (CORRECTED SCORES)

COUNTRY	BURUNDI	BURUNDI	MOROCCO	SWAZILAND	MALAWI	MALAWI	MALAWI	MALAWI	BURKINA	FASO	LIBERIA	NIGER	NIGER	NIGER	LESOTHO
AREA: REF. NO.	1a*	1b*	2**	3	4	5	6	14	7	8	9	10	11	12	13
NAME	KIBIRA	KIBIRA	MASSA	MALOLOTJA	KASUNGU	VWAZA	NYIKA	MWABVI	NAZINGA	COMOE-A CLERAB-A	SAPO	PARCW	TAMU	AIRE	SEHLABA THEBE
FACTOR A. BIOLOGICAL VALUE															
Size of Area A.1	12	12		20	16	12	16	12	12	16	16	16	12	20	8
Vegetation diversity A.2	8	12		20	8	16	20	8	16	20	20	16	12	12	4
Rare plants A.3	6	6		20	0	0	6	0	0	6	10	10	6	6	3
Rare animals A.4	6	6		10	3	0	10	3	3	10	10	6	6	10	10
Geology A.5	10	10		6	3	6	6	6	6	6	3	3	3	3	6
Ecosystem type A.6	30	30		3	5	5	30	5	5	5	30	5	5	10	15
TOTAL	72	76	50	79	35	39	88	34	42	63	89	56	44	61	46

* 1a and 1b are scores for Kibira National Park without and with the surrounding Forest Reserve, respectively.

** Individual factor rankings for Massa National Park are not available.

TABLE 1

(Continued)

COUNTRY	BURUNDI	BURUNDI	MOROCCO	SWAZILAND	MALAWI	MALAWI	MALAWI	MALAWI	BURKINA	FASO	LIBERIA	NIGER	NIGER	NIGER	LESOTHO
AREA: REF. NO. NAME	1a* KIBIRA	1b* KIBIRA	2** MASSA	3 MALOLOTJA	4 KASUNGU	5 VWAZA	6 NYIKA	14 MWABVI	7 NAZINGA	8 COMOE-A LERABA	9 SAPO	10 PARC W	11 TAMU	12 AIRE	13 SEHLABA THEBE
B. LANDSCAPE/ AMENITY															
Geological B.1	0	0		2.5	2.4	0	5	5	0	2.5	0	7.5	0	7.5	5
Floristic B.2	6	6		10	2	4	8	4	2	7.5	10	4	0	6	2
Faunal B.3	6.7	6.7		7	13.4	6.7	13.4	6.7	13.4	13.4	20	13.4	6.7	20	6.7
Scenic B.4	5	5		20	10	20	20	10	5	15	10	10	5	15	15
Cultural B.5	2.5	2.5		7	7.5	0	7.5	2.5	0	0	2.5	5	2.5	10	5
Recreational B.6	0	0		5	10	5	20	0	10	0	10	10	0	10	10
Access B.7	10	10		10	10	5	5	5	5	5	0	10	10	0	0
TOTAL	30.2	30.2	70	61.5	55.4	40.7	74.4	33.2	35.4	43.4	52.5	59.9	24.2	68.5	43.7
FACTOR C. SOCIO- ECONOMICS															
Conservation Awareness C.1	2.9	20		3	17.4	8.6	17.4	17.4	20	2.9	14.5	14.5	2.9	14.5	5.8
Conflicting land use C.2	12	12		4	9	12	15	15	12	15	12	15	9	12	12
National importance C.3	6	12		9	12	6	12	6	12	9	3	12	6	9	6
Economic potential C.4	8	8		16	12	12	16	8	20	20	12	12	4	12	8
International involvement C.5	6	6		6	6	6	9	6	6	3	6	6	3	12	6
Integration potential C.6	6	6		6	3	3.8	12	6	9	9	3	3	9	15	6
TOTAL	40.9	64	58	44	59.4	48.4	81.4	58.4	79	58.9	50.5	62.5	33.9	74.5	43.8

TABLE 1

(Continued)

COUNTRY	BURUNDI		MOROCCO	SWAZILAND	MALAWI				BURKINA FASO	FASO	LIBERIA	NIGER			LESOTHO
AREA: REF. NO.	1a*	1b*	2**	3	4	5	6	14	7	8	9	10	11	12	13
NAME	KIBIRA	KIBIRA	MASSA	MALOLOTJA	KASUNGU	VWAZA	NYIKA	MWABVI	NAZINGA	COMOE RAB-A	SAPO	PARC W	TAMU	AIRE	SEHLABA THEBE
D. CONSERVATION STATUS															
Legal Status D.1	4	4		4	8	8	8	8	8	4	8	8	4	4	8
Historical status D.2	3.2	3.2		1.6	1.6	1.6	1.6	1.6	3.2	4.8	3.2	4.8	0	6.4	4.8
Manpower resources D.3	0	8		4	6	4	6	6	6	4	6	4	2	4	4
Motivation and competence D.4	6.6	6.6		6.6	10	10	10	66	10	3.3	3.3	3.3	3.3	3.3	6.6
Funds and equipment D.5	0	8		5	5.3	5.3	5.3	2.6	5.3	2.6	5.3	2.6	2.6	5.3	2.6
Development & planning D.6	1.6	6.4		6.4	6.4	6.4	6.4	1.6	6.4	1.6	1.6	6.4	0	4.9	1.6
Research and monitoring D.7	2	0		4	6	6	6	2	6	0	62	6	0	6	2
Law enforcement D.8	2.6	5.2		5.3	5.3	5.3	5.3	5.3	2.6	2.6	2.6	2.6	2.6	2.6	2.6
Type of illeg. activity D.9	5.2	5.2		5.3	0	0	0	0	2.6	2.6	2.6	0	2.6	5.3	5.2
Poaching threat D.10	6	6		8	6	6	6	6	4	4	4	4	4	6	8
Land pressure D.11	0	0		2.5	2.5	2.5	2.5	2.5	5	7.5	2.5	2.5	5	10	7.5
Civil security D.12	8	8		8	8	8	8	8	8	8	5.3	8	8	8	5.2
TOTAL	39.2	60.6	35	60.7	65.1	63.1	65.1	48.2	69.8	43	46.8	54.7	31.6	65.8	58.1

The Nyika National Park, Malawi, is an area with high park values; it is a mountainous area relatively unsuitable for cultivation and containing woodland, subalpine grassland, and montane forest patches with a number of rare or endemic subspecies of animals and plants as well as spectacular scenery and important catchment value. The park is fairly well-developed and the conservation status is quite high. The major problems are due to population pressures around the margins, particularly by people who moved out within the last ten years when the park was extended. The point here is that the internal situation of the park is satisfactory with little illegal activity, so that future effort should be concentrated on its external relations with the surrounding population to improve its socio-economic situation. Possible avenues are through negotiating key points of boundary contention, developing its catchment value through gravity-fed rural water supplies, education and public relations and through developing nondamaging consumptive uses such as beekeeping.

Kasungu National Park, Malawi, is an area with a relatively low park value but high conservation status. The low park value is due to its representing a relatively widespread and unspectacular community and landscape (plateau miombo) while its socio-economic status is poor due to land pressure. The priority for this park is to improve its park value, since its conservation status is adequate. Possible avenues would be increasing animal biomass and sightability by the use of fertilizer and artificial grasslands, improving viewing with rides, night drives, wilderness trails, etc., improving recreational facilities with sports facilities, entertainment facilities, etc., and improving the socio-economic situation by reducing man-animal conflicts at the boundary with fencing, etc. This is the strategy used effectively at Pilanesberg Game Reserve in Bophuthatswana, which integrates the casino complex at Sun City with a range of amenities in the game reserve, including hunting, wilderness trails and conventional tourism.

Mwabvi Game Reserve, Malawi, is an area with both low park value and low conservation status. It is also unattractive to visitors on account of high temperatures and dense tsetse fly. Its primary importance is that it contains a small population of black rhino. Here it is very questionable whether either the park value or the conservation status can be significantly improved in the near future, and in this situation, serious consideration must (and has) been given to translocating the rhino to a higher status area (i.e., Liwonde National Park), abandoning the attempt to conserve Mwabvi and concentrating the resource savings elsewhere. The Mwabvi case also makes the point that category B (landscape and amenity value) should include a factor for visitor comfort (i.e., heat, tsetse, etc.).

Finally, the scatter diagram focuses attention on those areas which are of high park value but low conservation status. This is obviously the category that requires particular conservation effort in the form of funding and manpower to improve their status. The three points of this type are Sapo (Liberia) with primary rain forest with an unusual forest fauna; Malolotja (Swaziland) with spectacular scenery with rare animals, birds and plants (cycads); and Massa (Morocco) with scenic coastline, a rare bird population and high tourist potential.

In conclusion, most participants felt that the exercise had been interesting in that it forced them to examine carefully their motives in asserting the priority of a particular conservation project. Most felt, we think, that the method is still not perfectly worked out, but that it is worth putting effort into this type of analysis at both national and international levels, in order to provide a framework for the complex set of subjective decisions that has to be made when assessing conservation priority.

8. ASSESSING CONSERVATION PRIORITY--A BRIEF REVIEW:

Following the Lifupa workshop, we came to the conclusion that the methods of conservation priority scoring developed at Wankie (1981), Zimbabwe (1983) and Lifupa (1984) are heading in the right general direction but that they need a certain amount of rethinking. This brief review is intended to provide a starting point for the next attempt.

We would here like to touch on the following topics:

(i) The subjective nature of the process of allocating conservation priority;

(ii) The allocation of conservation value to species, communities, landscapes, etc.;

(iii) The distinction between national and international value;

(iv) The distinction between actual and potential value; and

(v) The logic of the conservation priority scoring system.

a. The Subjective Nature of the Process of Allocating Conservation Priority:

We are all aware that, to a large extent, the allocation of conservation priority depends on a set of subjective value judgements, or what Bell (1983) calls aesthetic decisions. This is not a bad thing, nor should it prevent us from trying to develop a system to handle it. As was emphasized at the workshop, the system provides a rational framework for this complex set of subjective decisions. We want to point out here that subjective decisions enter the process in two main ways:

The first set of subjective decisions forms the basis of our classification of the environment. As Clarke and Bell (in prep.) have emphasized, all forms of classifications are essentially subjective in principle. The division of objects into classes is done by man, not by the nature of the objects themselves. This is particularly evident in biology and geology where sets of objects merge both in time and space and where communities consist of statistical associations. Thus, the division of objects into classes is subjective, the grouping of classes into hierarchic levels is subjective, and the choice of which hierarchic level to refer to in assessing priority is subjective (Clarke and Bell, in prep.).

This problem is well illustrated by the case of the northern white rhino. This population is very severely endangered and is liable to become extinct unless active and expensive conservation measures are taken. However, the closely related southern white rhino is currently in a rather healthy state and expanding both in range and numbers. The question of the degree of relationship between the northern and southern white rhino populations now assumes considerable significance in assessing the priority of allocating sufficient funds and effort to save the northern population. If the two populations clearly belonged to distinct species, most people would rate the northern population very high priority; if to subspecies, much lower priority, and, if merely to local races, lower priority still. However, there is no objective method of deciding whether or not populations belong to distinct species, subspecies or races. The test of fertile interbreeding is no use; many full species interbreed. The decision is a purely subjective one.

The problem is still more evident in the case of biotic communities and vegetation types since these consist of relatively fluid complexes of species. Clarke and Bell (in prep.) have repeated the often expressed opinion that the production of a generally acceptable biotic communities map, albeit subjective, is itself a high priority conservation priority.

b.   The Allocation of Conservation Value to Species, Communities and Landscapes:

Once we have decided on a classification of species, communities and landscapes, we reach the second set of subjective decisions, that is the ordering of these classes into different grades of importance or value for conservation. Humans do not, in fact, attribute equal value to all aspects of their environment, and it is neither practical nor desirable that they should. In general, people appear to prefer vertebrates, particularly mammals, to invertebrates, trees to other plants, and mountains, water and open parkland to other landscapes, while they tend to place greater value on large organisms than small, rare than common and threatened than safe. These broad generalizations form the basis of the park values in the priority scoring system. The purpose of the scoring system is to set up in the open, the complex aesthetic system on which each person's feeling of conservation priority is based. At some point, this requires simply trying to make lists of species, communities and landscapes in orders that we can all agree on, or agree to disagree on.

Several such lists appear explicitly or implicitly in the various scoring systems. For example, in the Wankie system (Cumming and Jackson 1984), which was concerned primarily with rhino and elephant, the various species or populations were overtly listed in the following order of priority:

(i)   Northern white rhino,

(ii)   Black rhino (with five subspecies listed in order of priority),

(iii)   Southern white rhino,

> (iv)   Desert elephant (Namibia),
>
> (v)   West African forest elephants,
>
> (vi)   West African savanna elephants, and
>
> (vii) Central and East African elephants.

Here the primary criteria for high priority is rarity and threatened status.

The most detailed such list was used at the Zimbabwe 1983 workshop, where the biotic communities of the country were grouped as 26 "ecosystems," and were listed in order of "ecosystem value." Here, again, the primary criterion of ecosystem value is rarity. The ranking of "ecosystem type" at the Lifupa workshop (Factor A.6) is a simplified version of the same thing.

However, we feel that not all species, communities or landscapes of equal rarity are normally given equal value. For example, a small population of scimitar-horned oryx or mountain gorilla would usually be considered more valuable than a very rare fresh water minnow or butterfly. We feel, therefore, that in making up the lists of conservation priority, species, communities or landscapes should be given separate weightings for rarity and for what might be called aesthetic value for want of a better term. Of course, the two are not independent, rarity being a component of aesthetic value.

Thus, under the factors for rare animals and plant species, one could score a basic factor of, say, 10 for each endangered species and 5 for an endangered subspecies. This could then be multiplied by the following weighting factors, for example:

> x   2   -   Large mammal
>
> x 1.5   -   Small mammal
>
> x   2   -   Birds (raptors)
>
> x   1   -   Birds (others)
>
> x   1   -   Other vertebrates
>
> x 0.5   -   Invertebrates

> (Note, there is no need for category scores to add up to a fixed total, a fact which simplifies the logic of the scoring system.)

These categories and weighting factors could be expanded at will; all mammals, for example, could be weighted individually. It would be an interesting test of aesthetic capabilities, but it is far from being a purely academic exercise. Conservation funding and wildlife legislation (see Clarke and Bell, Chapter 34, this volume) are based on precisely this type of evaluation, although it is usually carried out subconsciously.

The same weighting can be carried out with communities, landscapes and other features. It is here worth noting that the often stated conservation objective of preserving representative examples of biotic communities (cf., Elliott 1974, Lamprey 1976, among others) is given a much more precise focus by the method of identifying conservation priority outlined here (cf., Cumming 1984 and Clarke and Bell, in prep.) While identifying poorly represented communities may be a useful first stage, it is clear that each community is very uneven internally in conservation value as a result of the many physical, biological and socio-economic factors identified in the present system. For this reason, Clarke and Bell (in prep.) have proposed that the wording of the World Conservation strategy objective should be altered from the preservation of "representative" examples to the preservation of "selected" examples. This slight semantic difference corresponds to a rather important conceptual difference in the approach to identifying conservation priority.

c. **National and International Priority:**

The question of national and international priority was not a problem at the Wankie and Zimbabwe workshops since the former was strictly international and the latter strictly national in scope. At the Lifupa workshop, the question was unevenly treated and we feel that it should be clearly addressed in future exercises of this kind.

The point is that, a species that is rare in one country, but relatively common and well-protected elsewhere (like nyala in Malawi, sable in South Africa or roan in Niger) may rate high national priority, but will rate lower priority in international terms and may even be classed as marginal and of low priority (cf., Grimsdell and Raw 1984, in relation to marginal frogs in Natal). A true endemic, however, such as mountain nyala in Ethiopia or black lechwe in Zambia, rates a higher priority in both national and international terms.

This distinction can be dealt with by giving different weightings to features which are globally and nationally unique and adding these to the weighted scores if they are also rare. This would apply to animals and plants as well as to geological, scenic, cultural and archaeological features. Such a weighting was applied to category B (Landscape and Amenity value) at Lifupa, but not to category A (Biological value). The relative weightings of nationally and globally unique features may need to be adjusted when using the scoring in a national or global context.

d. **The Distinction Between Actual and Potential Values:**

This point has not been treated clearly in the scoring systems to date. For example, the questionnaires do not allow a distinction between an area with a high carrying capacity from which all animals have been

eliminated, and one with a low carrying capacity. The actual present situation may be similar but the potential very different. The same is true of floristic attractions, recreational attractions, accessibility, and consumptive and nonconsumptive uses. In each case, a separate factor is required for the actual current situation, for the potential, and for the cost of reaching the potential. The same is true of rare species; the potential for introduction or reintroduction of rare species should be considered, as for example, the northern white rhino to Murchison Falls National Park (not that we recommend this at this time), the black rhino to Liwonde (Malawi), or the black wildebeest to Sehlabathebe (Lesotho).

e. **The Logic and Layout of the Conservation Priority Scoring System:**

This leads us on to our main suggestion which suggests a revision of the layout of the scoring system on the basis of a rethink of the underlying logic.

It seems to us on reflection that the scoring system as developed so far is heading in the right direction, but is getting a little bit muddled in the grouping of factors, implying that the causal relationships between the factors are themselves a bit confused.

We suggest that the factor be resorted into three categories as follows:

A/AREA VALUE: This category includes those factors which contribute directly to the primary objectives of conservation, that is, prevention of extinction, maintenance of selected communities and preservation of landscape aesthetics.

B/PROBLEMS AND COSTS OF CONSERVATION: This category includes all those factors that contribute to the difficulty and costs of conserving the area, that is, of keeping the state of its components within specified limits to permissible change. This category represents the size of the discrepancy between individual short-term interests and the interests of conservation.

C/MITIGATING FACTORS: This category is approximately equivalent to conservation status. It includes all those factors which contribute to reducing the discrepancy between interests opposed to and in favor of conservation, that is the efforts and expenditures put in and the revenues and other benefits accruing as a result.

In each case, a distinction is made between actual and potential values, problems, costs, revenues and benefits.

The factors included under each category are as follows (some are similar to those used in previous scoring systems, some are new, and some have been dropped as redundant):

A/AREA VALUE (ACTUAL & POTENTIAL WHERE APPROPRIATE)

A.1   Size of area

A.2   Community diversity

A.3	Rare and endemic plants
A.4	Rare and endemic animals
A.5	Biotic community value
A.6	Special geological features
A.7	Special floristic features
A.8	Special faunistic features
A.9	Animal biomass
A.10	Animal carrying capacity
A.11	Landscape value
A.12	Cultural value
A.13	Archaeological value
A.14	Recreational value

B/PROBLEMS AND COSTS OF CONSERVATION (ACTUAL & POTENTIAL WHERE APPROPRIATE)

B.1	Geomorphological problems (i.e., erosion, subsidence, etc.)
B.2	Climatic problems (i.e., drought)
B.3	Ecological problems (i.e., overstocking)
B.4	Human density
B.5	Rate of human increase
B.6	Land use conflicts
B.7	Land ownership conflicts
B.8	Unwanted (illegal) uses of area
B.9	Agencies of unwanted (illegal) use
B.10	Civil security
B.11	Damage to life and property
B.12	Access problems
B.13	Estimated direct costs of e�ctive conservation
B.14	Estimated indirect costs due to lost opportunity

C/MITIGATING FACTORS (ACTUAL & POTENTIAL WHERE APPROPRIATE)

C.1   Attitudes; local

C.2   Attitudes; government

C.3   Attitudes; international

C.4   Current expenditure

C.5   Current manpower; numbers

C.6   Current manpower; competence/morale

C.7   Existing infrastructure and investment

C.8   Existing equipment

C.9   Revenue; nonconsumptive uses

C.10   Revenue; consumptive uses

C.11   Research/monitoring capability

C.12   Law enforcement capability

C.13   Education/P.R. capability

C.14   Crop protection capability

C.15   Organizational capability

C.16   Legal status

C.17   Catchment value

C.18   Social/recreational benefits

We envisage the scoring system as follows: Area values would be indicated on a central vertical A axis. Problems and costs would be counted as negative scores counted horizontally from the central vertical A axis, while mitigating factors would be counted positively on the same horizontal. Thus, each area would be represented by a horizontal bar, the height on the A axis indicating the Area value, the left hand end representing the problems and costs, and the length of the bar representing the extent of mitigating circumstances. If the mitigating circumstances outweigh the problems and costs, the right hand end of the bar should recross the central A axis and indicate that the area has some hope of survival as a conservation area. Each area could be represented by two bars, one for actual and one for potential values. A hypothetical example is given in Figure 2.

FIGURE 2

**PROPOSED SCORING SYSTEM FOR ASSESSMENT OF
CONSERVATION PRIORITY**

INCREASE INPUT

A. (POTENTIAL)

A. (ACTUAL)

VIABLE WITHOUT
FURTHER INPUT

AREA VALUES

INCREASE INPUT
REDUCE INPUT

B. (ACTUAL)

C. (ACTUAL)

REDUCE INPUT

0

PROBLEMS AND COSTS

MITIGATING FACTORS
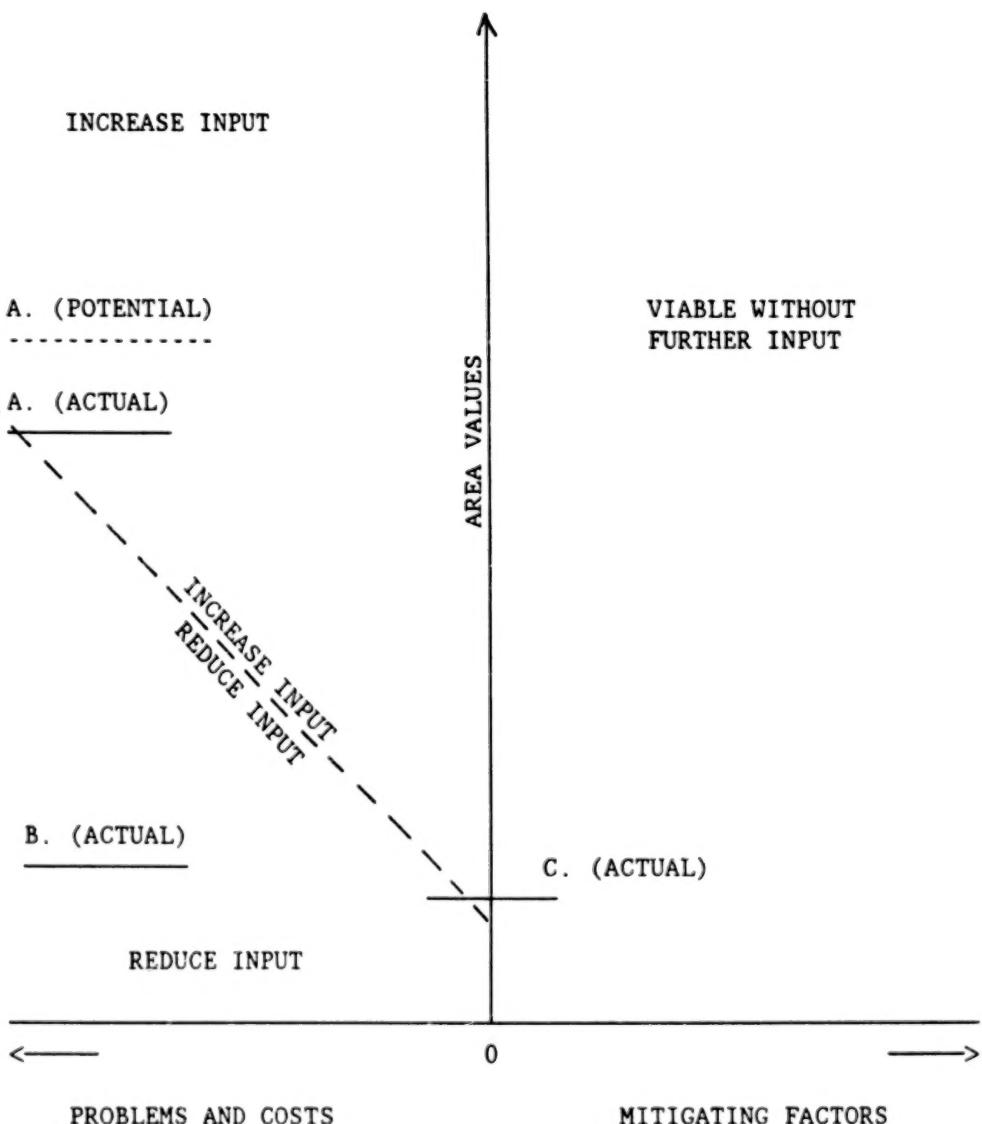
This figure shows an area A, of high area value but high problems and costs and low mitigating circumstances. This area will require either modification of objectives to bring it closer into line with local interests or a massive injection of external funding and effort to survive as a conservation area, but its high area value indicates that these efforts will be worth it. Area B, on the other hand, has lower biological value, high costs and low mitigating factors, leaving an equally large shortfall; with its low area value, the principle of "triage" any indicate abandoning it. Area C has low area value but low problems and costs, and even with low mitigating factors still has a favorable balance and can coast along without much aid.

This format emphasizes the point that the costs of conservation are proportional to its unpopularity and that there are two ways of reducing the gap between popular interests and conservation interests. One is to modify conservation objectives to integrate more fully with local interests, the other is to buy off or override popular interests by means of external effort and funding. Whether one scores local attitudes as a cost or a mitigating factor is not too important since a high score as a cost is exactly equivalent to a low score as a mitigating factor.

On the details of scoring, there is no compelling reason why each category total should have an upper limit. By using an open total in each category, the scoring system becomes more realistic and flexible. For example, special features such as rare animals and plants can be scored additively, as suggested earlier. This would allow a more realistic weighting to areas such as montane forests, the Rift Valley lakes or the Cape Fynbos, which have very high levels of endemism.

9.   **CONCLUSIONS:**

The problem of allocating priority to conservation effort assumes increasing urgency as pressures on natural resources build up and the world's economic resources are progressively stretched.

At present, the allocation of attention, effort and funding to conservation is done on a largely ad hoc basis in response to a barrage of pressure from special interests with pet projects. This is as it should be; any monolithic system is bound to miss out aspects which are not generally recognized as valuable now but may turn out to be so in the future.

However, we do need, both at the national and international level, a system for organizing this mass of subjective judgements and relating them to the costs and inputs associated with conservation in its various forms. We need a means of weighing the balance between costs and inputs and relating this to the value of the area on the one hand and potential sources of inputs on the other.

We recognize and emphasize the major subjective element in any such system. In fact, what we are toying with here are the first elements of a complex model of human psycho-socio-economic responses to natural resources. We must also recognize that there are two divergent uses to which such a system can be put.

Firstly, the system may be used in an attempt to produce an empirical and objective assessment of where priority is in fact allocated by different sectors of the community, with the objective of assessing the probability of support and survival of a particular project.

Secondly, the system may be used as yet another propaganda tool in the service of special interests and pet projects. This is because opinion may be influenced by the results of the scoring system. If, for example, national governments or funding agencies accepted the priorities identified by the scoring system, then project priority could be modified by manipulating the weighting factors and fudging the scores. This tendency has been evident whenever the scoring system has been used.

As usual, no doubt, the trend will be a blend of objectivity and propaganda. Well, that's conservation.

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SECTION 2

TECHNICAL CONSIDERATIONS

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CHAPTER 6

RESEARCH PRIORITIES: WHAT DOES MANAGEMENT NEED TO KNOW?

BY

R.H.V. BELL

1. INTRODUCTION:

The purpose of this paper is to emphasize five points concerning research related to wildlife management and conservation in Africa.

a. Research is expensive in money and manpower and must, therefore, concentrate on questions for which answers are needed by management to achieve its goals;

b. However, there is a logical difficulty in identifying research priorities, the research priority paradox, due to the fact that, if one does not understand a system, one cannot identify priority components for study;

c. A strategy is suggested to circumvent this paradox;

d. A suggested list of priority topics is given; emphasis is placed on the human factor in wildlife management and conservation, and in consequence social and economic studies are given high priority in research; finally,

e. Research cannot be separated from management; these two types of work form a continuum of activities operating together in a system of adaptive management; conservation agencies should be formally structured to operate with integrated adaptive management teams as the basic functional unit.

2. RESEARCH IS EXPENSIVE--IS IT NECESSARY?

Wildlife research is expensive in money, time, equipment and trained manpower. The current research master plan for Malawi's national parks estimates that to establish a basic field research unit for one national park, in terms of buildings, vehicles, equipment and training, costs around US $150,000 while the annual running costs of such a unit are around US $30,000, that is, between 25% and 50% of the estimated recurrent expenditure of a national park as a whole at present levels of management.

This is heavy expenditure in the current economic climate of acute financial austerity. Is it really justified? Is research, certainly at this level, really necessary?

The first point to emphasize is that research is not necessary in the sense that the great majority of wildlife management in Africa has taken place, and continues to do so, without the benefit of formal research. Most conservation organizations either have extremely limited research capability, or support research that is not relevant to, or not used by management (cf., Bell 1980). It is probably safe to maintain, therefore, especially in the current economic environment, firstly that many conservation agencies do not have the management capability to take advantage of research if it were present, and secondly that no irreparable harm will be done to wildlife resources in the absence of research for the time being.

What is required, therefore, is a realistic balance between the research and management capability; to achieve this, a clear definition of research objectives is needed. I offer the following definition for this purpose:

> "The objective of research within a conservation agency
> is to improve understanding of the complex systems,
> ecological, economic and social, for which the agency
> is responsible, in order to allow the agency to achieve
> its objectives more effectively and economically."

If one accepts this definition, it is hard to sustain the argument that research is unnecessary unless one maintains either that the agency has no objectives or that it is operating at maximum efficiency. However, the definition emphasizes the intimate involvement of research in management, that research is in fact one aspect of management. This is in fact the basic tenet of the adaptive management theme, that there is no formal distinction between research and management, that acts of management should be used as experimental tests of our understanding of the systems managed, and that, as a result, inquiry will be directed towards questions of management significance (cf., MacNab 1983).

The basic question, then, in defining research priorities is this:

> "What does management need to know in order to reach
> its objectives more efficiently?"

3.   THE RESEARCH PRIORITY PARADOX:

In answering this question, any research organizer is immediately confronted by the following paradox (Bell 1980):

Because of limited resources, research must concentrate on a carefully selected set of priority topics, in our case, concerned with those system components that are important to management.   But, because we do not understand how the system works, we cannot anticipate which components will turn out to be important.   So, if we establish a rigid system of research priorities on the basis of what we think we know now, we can be certain that we will overlook some important components.

This research priority paradox lies at the heart of the argument between pure and applied research, and indeed of all arguments over research policy and funding.   Governments and funding agencies are more likely to support research of which the utility is clear, and thus automatically bias themselves against more original research programs which by definition conflict with current understanding.   Such programs are of course more risky; they are less likely to pay off, but if they do, they are the jackpot winners rather than utility pot-boilers.   The peer group review process, as used for example by the U.S. National Science Foundation, is intended to overcome the problems of identifying research programs of high potential, but as Broad and Wade (1983) have pointed out, this review process is itself highly arbitrary and liable to bias.   This should not be surprising since the research priority paradox stems from the basic tenet of logic, that one cannot validly extrapolate from the known to

the unknown, one cannot tell in advance what will be found out, nor when it will be found out, now how much the search will cost.

In short, the management of science is not itself a science; it is an art akin to gambling in which the logical strategy is a blend of caution and inspired rashness; it is necessary to study the form, hedge one's bets and play the occasional wild card, preferably at someone else's expense.

4. A STRATEGY FOR RESEARCH DESIGNED TO OVERCOME THE PARADOX:

In order to overcome the research priority paradox, we have proposed the following strategy for research in African conservation agencies:

a. Initiate a program of high priority management related studies, using agency staff and funds and resources (i.e., housing, equipment) directly under agency control. A suggested list of topics is given in a later section, as well as an organizational structure for integrating the program with the agency as a whole;

b. Develop a facility for detailed basic research with appropriate laboratory and technical facilities (i.e., for soil and vegetation analyses, feeding trials, data processing, etc.) to facilitate, as a service to field units, more detailed field studies. Ideally each national conservation agency should develop such a facility, but in practice, resources are limiting. There are many points in favor of developing such facilities on a regional basis. While in most cases, such facilities would have to be donor-funded, they should come under the control of local conservation agencies, or if regional, under a board representing member agencies;

c. Encourage externally based research workers or institutions to carry out projects on topics of their choice, (not necessarily related to the priority system, and therefore providing a means of breaking out of the paradox at minimum cost to the agency), on the following conditions:

   (i)   Externally based projects do not conflict with the management goals for the area (i.e., in terms of killing animals, visual impact, etc.);

   (ii) Projects do not make use of agency resources (funds, vehicles, manpower, etc.) required for priority projects. It will, however normally be necessary to allocate housing to such external projects at minimal cost; and

   (iii) Project workers should enter a formal agreement with the agency concerning conduct, sharing of data, samples, photographs, etc., and publication of reports on the project.

d. Develop communications with other research organizations; wildlife researchers are particularly liable to work in intellectual isolation because of the nature of their

geographical situations. It is essential to develop good communications with other workers and institutes in the same field, to have good access to literature, and to have frequent contacts through visits and meetings. This is the primary means of overcoming the research priority paradox, and incorporating areas of interest previously given low priority.

5. WHAT DOES MANAGEMENT NEED TO KNOW? A SUGGESTED PRIORITY LIST:

What does a wildlife management or conservation agency need to know in order to achieve its goals more efficiently? The answer of course depends on the goals. Let us assume for the moment that the basic goal of most such agencies may be summarized as follows (cf., Bell 1983):

> "To maintain within specified limits to change certain
> selected biological communities and landscape and to
> encourage specified consumptive and nonconsumptive uses
> without prejudice to the status of the communities and
> landscapes so defined."

a. Inventory and Landscape Classification:

First of all the agency needs to know the identity of the principal items for which it is responsible; it needs *inventory*. But it does not initially need an exhaustive list of all species of animals and plants or all physical resources. It needs initially to know only of the major species and resources which are liable to experience unacceptable changes and which are important determinants of the potential for various forms of use. These are usually as follows:

(i)   Broad aspects of climate (temperature and rainfall);

(ii)   Broad description of topography, geology and soils;

(iii)   Description of water resources;

(iv)   Broad description of major vegetation features, particularly species lists of principal trees and grasses, plants of special interest (i.e., orchids, cycads, etc.) or value (timber trees, medicinal plants), by area;

(v)   Broad description of fauna, particularly species lists and density indices of large mammals (greater then rabbit size), principal bird species, fish of food or sporting value, any species of special interest or value and species liable to cause disease or other problems (i.e., tsetse, crocodiles, etc.); also to be indicated by area; and

(vi)   Broad description of human social and economic involvement in the area, i.e., distribution of settlement and infrastructure, livestock and cultivation; particular attention should be paid to patterns of use of wildlife resources (animals, plants, etc.), water and minerals and to any strong cultural or religious attachments in the area.

The degree of detail included in initial inventories is, of course, determined by time and resources available. However, it is important to spread the inventory evenly over the above topics. Further detailed investigations of particular aspects (i.e., plants, small-mammals, birds, insects, reptiles) can be carried out later as non-priority topics by externally based workers.

In each case, the inventory should be area-specific. The logical framework for such an area-specific inventory is the landscape classification, described in detail in Chapter 8. Suffice it to say here that landscape classification provides a means of describing physical and biological resources by area at whatever scale is deemed appropriate. It identifies the functional units of ecosystems and provides a means both of understanding and managing natural resources.

b.   Identification of Specific Objectives:

On the basis of the inventory, the agency needs to identify its specific objectives for the area in question, that is, to specify the permissible limits to change for the area and hence the types and amounts of consumptive and nonconsumptive uses and types of ecological change compatible with those limits.

Bell (1980 and 1983) has emphasized that these decisions are ultimately aesthetic decisions based on subjective value judgements, but that selected options should be drawn from the class of options that are technically sound rather than the class of impracticable options. The identification of the class of sound options requires a technical input and a close feedback between trial and results in a typical adaptive management structure. For example, the initial objective of the agency may be to create a conservation area in a previously settled area and to make it politically viable by paying dividends to local residents from some form of consumptive use. Whether or not such a scheme is practicable depends on a range of biological (i.e., carrying capacity, sustainable yield), economic (market values, production costs) and social (participation, distribution of dividends, cultural attachment to land) factors, the balance of which may not be anticipated accurately; the final decision as to the objective must depend on a trial period with adequate technical feedback.

c.   Monitoring:

Monitoring consists of keeping track of the components of a system, specifically to assess their progress in relation to the objectives set for the system, (Bell 1983). But which components and in how much detail, do we need to monitor?

Grimsdell (1978) and MacDonald and Grimsdell (1983) have provided detailed guidelines on monitoring and methods for African conservation areas. These guidelines, however, are concerned almost exclusively with strictly ecological monitoring within protected areas, and it is necessary again to emphasize that monitoring is laborious and expensive (as well as being of no value or misleading if not properly carried out) and should be kept to the barest essentials, that is, to those components that it is absolutely essential for management to keep track of.

We need, in fact, to take a broader view of monitoring, as with other aspects of research, than has been customary. The point to recognize is that monitoring is a basic feature of adaptive management by which information is fed back from results to modify and improve performance of any class of action, be it in ecological manipulation or pure administration. Thus expenditure returns are a form of monitoring, as are stores inventories, the Dow-Jones index, economic and social reports on human populations, human census figures, public opinion polls, visitor use statistics, assessments of illegal activity and crop damage, catch per effort returns from hunting and culling, as much as woodland monitoring and wildlife censuses.

One of the main objectives of this workshop is to emphasize that every branch of management should be treated as a self-improving process, and should be structured as such, with adequate design, adequate monitoring and means of improvement, modification or termination as appropriate. Details of appropriate methods are given in later papers on monitoring of illegal activity and law enforcement, crop damage and its prevention, and public opinion polling.

Briefly, the basic guideline on monitoring is taken from MacDonald and Grimsdell (1983): the decision to continue monitoring can be based on whether or not the data are actually being *used*. One can extend this to say that where the objective for an area or a particular management practice is specified (as it should be) in terms of the states of components of the system, then those components should be monitored. For example, where the objectives for conservation areas are specified in terms of certain parameters of woodland structure and key animal densities, as they are in Malawi's protected areas, (Clarke 1983), then those parameters must be monitored.

If objectives are specified in terms of some level of consumptive use, then catch per effort returns, as used by fisheries, may be adequate. Where the objective of a particular management regime. i.e., culling, is to improve public relations by generating revenue and meat, etc., (cf., Komba 1983), then public opinion must be monitored (see Chapters 30 and 31). If the objective of law enforcement is to reduce illegal activity, then the rate of illegal activity must be monitored to see if law enforcement as currently carried out is actually having that effect; if not it must be improved. If the objective of problem animal control is to reduce losses to life and property by wildlife, then losses must be monitored.

Thus monitoring should be built into the complete range of activities from pure research to pure administration. Whether it is called research or management is immaterial; it is an integral component of adaptive management, and is essential if the agency is to improve its performance on a systematic basis.

d. **Basic Research:**

The objective of basic research, that is research without an immediate management application, is to provide a deeper understanding of systems so that their probable responses to various conditions may be anticipated.

In wildlife management we are faced with potentially unlimited systems containing physical, biological, socio-political and economic components; they are systems of enormous complexity that are only partially understood. The size of the task is daunting. Where should we start?

Bell (1980) has argued that there are three areas of primary importance from the point of view of wildlife management and conservation, which should receive priority in the allocation of effort to basic research. They are:

(i)   The physical inputs (topography, soils and climate);

(ii)   The plant-herbivore interaction; and

(iii)   Socio-economic studies of the human population.

The first two topics are discussed in more detail in succeeding papers on landscape classification, soil-plant-herbivore interactions and tree response to elephant damage. No more need be said here.

The third topic, socio-economic studies, is invariably underrepresented in wildlife-related research. This point is the main thrust of the succeeding papers by Rowan Martin on environmental research and of the workshop exercise in integrated modelling summarized in Chapter 14.

The point to emphasize here is that the compilation of a land use plan for an area implies that whoever compiles it is not satisfied with the existing form of land use and intends to try to persuade some or all of the people concerned to modify their life style in ways they would not ordinarily have done. The implementation of such a plan is primarily a political and social exercise, and failure to recognize this fact characteristically leads to failure of the plan. It is, therefore, essential to understand the political, social and economic interests of the people concerned and this must be recognized as a priority area for research, difficult though it is.

A final point should be made concerning basic research, a point which has been emphasized by MacNab (1983). This is that basic research in environmental ecology, as in the social and economic sciences, is hampered by the lack of opportunities for experimental manipulation with which to test hypotheses and models, since such experiments are illegal, unethical or in conflict with management goals. In consequence, both in the ecological and socio-economic sciences, untested theories of uncertain outcome are regularly put into practice as management regimes or government policies, and for this reason, management itself provides the only opportunities for testing hypotheses by experiments, and in this sense is itself a branch of basic research. As MacNab (1983) urged, this requires that each act of management should be treated as the important research opportunity it is, as a trial of a theory, and should be designed as such with adequate controls, carried out with adequate facilities for recording input and performance, and followed up by evaluation and if necessary, modification. An excellent example of this type is the Lengwe culling program reported in this workshop by John Mphande and Haxwel Jamusana, Chapter 19.

e.   A Short List of Research Priorities:

I attach, herewith, a short list of research priorities suggested for use *within* a protected area, rather than a wildlife area containing settlement or pastoralism.   As usual the socio-economic aspects are underrepresented. This bias should be corrected by Rowan Martin's papers emphasizing these aspects.

A typical research program for a terrestrial protected area is here suggested as an integrated package:

(i)   Landscape classification, providing the stratification for other data gathering;

(ii)   Installation of rain gauges and met. recording, using monthly storage gauges, see Grimsdell (1978);

(iii)   Identification of the vegetation, particularly grasses, trees and plants of special interest;

(iv)   Installation of woodland monitoring system;

(v)   Installation of fire trial plots;

(vi)   Census or index of numbers of key animal species by area and season;

(vii)   Monitoring of illegal activity and law enforcement;

(viii)   Monitoring of crop damage and control measures;

(ix)   Monitoring of visitor use and opinions;

(x)   Monitoring of public opinion;

(xi)   Monitoring of management regimes such as sport hunting, culling and other forms of use of wildlife resources; and

(xii)   Monitoring of human populations, livestock and land use practices in surrounding areas.

This work program is already quite extensive.   However, it is seen as an ongoing program in which the first steps are to establish the monitoring procedures in such a way that they can be taken over and carried on by junior and middle level staff and data processing carried out by computer. This aspect should be seen as much as a training program as a research program.

Once the monitoring programs are running independently, senior staff can concentrate on more detailed research activities.   Management staff should be actively involved in the program, particularly in the management monitoring aspects, with advice and assistance from research staff.

6. THE ORGANIZATION OF RESEARCH--AN ADAPTIVE MANAGEMENT STRUCTURE:

For research to fulfill the role envisaged for it in this paper requires not an organization for research but a restructuring and reeducation of the whole agency as a profession operating by adaptive management. It requires, first and foremost, that management should recognize its information requirements and take steps to fill those requirements; it should realize what it needs to know and act accordingly.

In such a profession, it is recognized that the system being managed are exceedingly complex and poorly understood, so that the outcome of any act of management is characteristically in doubt. Each act of management, therefore must be designed as a trial, with adequate recording of procedures and monitoring of results, to allow the act of management itself to act as a test of the theory on which it was based. Management, then is itself a branch of research, and research methods must be involved in its design, execution and evaluation.

Whether it is necessary to divide the agency into distinct management and research branches is open to debate. Currently, this is of less consequence than formerly, since the present trend in Africa is for all senior staff to receive equivalent professional training. However, it is certainly true that agencies will require at least a core of research specialists to design procedures, process data and carry out special techniques. It is also true that management teams will need to be strengthened to carry out the extra work load imposed by adaptive management procedures.

If a distinct research section is required, then at each level (national, regional, protected area, etc.), research personnel must be integrated in two dimensions:

Firstly, they must be integrated with the research branch, in terms of administration, training, specialist direction and supply.

Secondly they must be fully integrated with the appropriate management team including other branches of the agency, i.e., management, planning, public relations, etc. Those management teams should be the functional units of the agency which should together design, execute and evaluate all management procedures, with the necessary information-gathering and self-correcting features built in to them.

The research worker is thus subject to a dual control, from his research director and from the head of his management team (see also Chapter 35). This type of dual control is standard procedure in military organizations, for example, where specialist units (i.e., intelligence units, air units, artillery units, etc.) are administered, trained, and supplied by their parent services but come under the tactical control of integrated interservice group commanders. This type of dual control is well described by Suvurov (1982).

7. CONCLUSION--THE TIP OF THE ICEBERG:

To discuss research priorities for wildlife management and conservation is to sculpture the tip of the iceberg. What is needed, in my view, is a general reeducation of conservation agencies as a whole to the concept of adaptive management.

This can be done by starting at the bottom through training programs and college curricula for senior, middle and junior level staff, as well as by permeation of the concept through staff in service. I would argue that the present moment is particularly favorable to this type of initiative, since the staffs of many conservation agencies in Africa are mainly sound, professionally trained (unlike their expatriate predecessors), highly motivated and open to new ideas. Added to this, members of all branches tend to share common professional experiences and training and may be expected to be able to integrate more easily into integrated adaptive management teams than their predecessors.

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CHAPTER 7

LANDSCAPE CLASSIFICATION

BY

R.H.V. BELL & T.O. McSHANE

1. INTRODUCTION:

Landscape classification is the essential first step in any form of land use planning because it provides the means both of understanding and managing an area.

Many aspects of land use are site-specific, that is, they depend on the particular physical and biological features of the area in question. This is true of choice of goals, the problems in reaching those goals, and conservation priority as well as assessing carrying capacity, productivity, landscape aesthetics, agricultural and livestock potential, and the costs of infrastructure development.

Therefore, when the question of land use planning arises, the first requirement is for a description of the area that classifies its sites into sets and so provides an integrated area-specific summary of its physical and biological characteristics that will in turn allow a range of predictions concerning the management problems and utilization potential of each of part of the area to be made.

The various methods of land description relevant to wildlife management were reviewed by Astle, Webster and Lawrance (1969); they concluded that the system of landscape classification was the most appropriate. Since then, the increasing use of the method in this field has amply confirmed their view.

2. WHAT IS LANDSCAPE CLASSIFICATION?

Landscape classification is a method of categorizing areas of land in such a way that a range of physical and biological information is contained in the description of each landscape category. This range includes geology, topography, soils, climate, vegetation, animal use and human use. The description of each category therefore contains much more information than a land classification based on a single feature such as soil or vegetation, and in consequence has a wider range of applications, in stratification for research, and in planning the management and use of natural resources, agricultural uses and infrastructure development. In short, landscape categories can be regarded as the functional units of ecosystems.

Landscape classification as an independent science was developed in the 1960s as a result of the expanding use of aerial photographs in land surveys (see Young 1976 for a brief review), and lately of other forms of remote sensing such as satellite imagery. The method was first applied to an African conservation area by Astle, Webster and Lawrance (1969) in the Luangwa Valley, Zambia, and has subsequently been applied to the Serengeti National Park, Tanzania (Gerresheim 1974, de Wit 1978, Jager 1982), Kruger National Park, South Africa (Gertenbach 1983), various areas in Zimbabwe (i.e., Martin and Taylor 1983) and various areas in Malawi (Bell and Mphande 1980, Bell 1981a, Bell 1984a, and McShane 1984), and the Lupande Game Management Area, Zambia (Dalal-Clayton, *et al*. 1983) among others. A recent review of the method is given by Pritchard (1979).

3.   THE LOGIC OF LANDSCAPE CLASSIFICATION:

We have defined landscape classification as a system in which a range of physical and biological information is contained in the description of each landscape category. However, Young (1976) has pointed out the lack of logical rigor in a system in which every environmental variable is itself part of the definition of the units of the landscape. This is because no single variable will be perfectly correlated with any mapping unit unless the variables used in defining those units are perfectly correlated with each other, a rare or nonexistent condition.

In the construction and use of a landscape classification system, therefore, it is necessary to distinguish clearly between three sets of environmental variables, as follows:

a.   Those variables in terms of which each landscape category is defined (usually geomorphology, climate, topography and soils);

b.   Those variables that are in practice used to identify each landscape category from ground surveys and remote sensing, etc. (usually topography, vegetation and cultivation); and

c.   Those variables that are correlated or associated to greater or lesser degrees with the landscape categories so defined and identified (i.e., geology, vegetation and animal and human use).

The use of landscape classification, with its integrated descriptions of landscape categories is based on the hypothesis that there are causal interactions that run right through ecosystems, producing at least partial correlations between the whole series of physical and biological variables. The current trend is towards quantitative or parametric description of land character.   A thoughtful review of the logic of landscape classification and the value of the parametric approach is given by Mabbutt (1968).   He reaches the conclusion, with which we concur, that landscape classification is eventually subjective in nature although this does not detract from its usefulness if subjectively derived rules and guidelines are used in a systematic way.

The value of the system lies in its ability to predict a range of associated features (i.e., vegetation, animal use, land use potential) from the defining and descriptive features.   Its ability to do so will depend upon the accuracy of the classifier's hypotheses concerning associations between environmental variables.   At the same time, if used rigorously as suggested above, the system provides the means for quantitative testing of these hypotheses and improving them if necessary.   The system of landscape classification therefore embodies the very essence of adaptive management in that it contains the capability of improving both our understanding of, and our ability to manage, ecosystems, by a series of interactive approximations.

4.   THE HIERARCHY OF LEVELS IN LANDSCAPE CLASSIFICATION:

Most systems of classification, of whatever kind, are hierarchic, that is, they consist of a series of levels.   The units at each level are split

into smaller units at the next level down. Each unit is what Arthur Koestler (1967) calls a "holon", meaning that each unit is both a whole containing parts, and part of a larger whole.

Landscape classification is a young science, and for Africa at least, there is no real uniformity either as to which variables should be used to define each category, or as to what degree of diversity should define the cutoff between each hierarchic level of categories, or as to what each hierarchic level should be called.

The primary mapping unit has sometimes been called the *land system*, defined originally as "an area with a recurring pattern of topography, soils and vegetation," (Christian and Stewart 1963, quoted by Young 1976). Young (1976) points out that such units may vary widely in size from 10 km^2 to 1000 km^2, both on account of differences in landscape type and of survey intensity; however, Brink, *et al.* (1966) and Astle, *et al.* (1969) note that such *land systems* are usually suitable for mapping at scales of 1:50,000 to 1:1,000,000.

Some landscape classifications use only this level of division, for instance, that of Gertenbach (1983) for Kruger National Park, South Africa. However, most subdivide the *land systems* into *land facets*, suitable for mapping at scales of 1:20,000 to 1:50,000, while some further subdivide *land facets* into *land elements* (Brink, *et al.* 1966; Christian and Stewart 1968; Astle, *et al.* 1969). At the other end of the scale, *land systems* are combined into larger *land areas* and *land regions* (i.e., Mansfield, *et al.* 1976).

5.   A TENTATIVE DEFINITION OF LANDSCAPE CATEGORIES:

Most of the above terms have been used in different ways by different people. Considerable confusion exists over the category definitions and their names. It would, of course, be highly desirable to develop a consistent set of landscape classification categories for use on an Africa-wide scale, since this would allow direct comparisons between, say, Kasungu National Park, Malawi, and Parc "W", Niger. We would here like to suggest a tentative set of category level definitions for discussion and trial to see if we can work towards a common ground. However, we recognize a basic difficulty that all classification systems are fundamentally arbitrary, both in defining the limits of any category and in defining the cutoff quantities of diversity between any hierarchic level (cf., Clarke and Bell, in prep.) What we are aiming for, therefore, is a consensus on a practicable system rather than pure academic rigor. Our suggested definitions are as follows:

I   **Land Region:** A major geomorphological region such as plateau, escarpment, mountain range, volcanic massif, or rift trough, containing considerable variations of geology, slopes, drainage patterns, soils, climate, vegetation, fauna and land use.

II   **Land Sub-Region:** A primary division of a land region on the basis of major geomorphological or climatic

features, having significant effects on soils, vegetation, fauna and land use. Examples would be the division of a plateau region into subregions on the basis of presence or absence of sand cover (aggradational/degradational) or of major rock type (base rich, base poor, etc.); the division of an escarpment region into subregions on the basis of escarpment type (i.e., erosional, down-throw fault, echelon fault, step fault, monocline, etc., see Crossley 1984); or the division of a mountain region on the basis of rainfall (orogenic rainfall area, rainshadow, etc.)

III **Land Area:**   A division of a land subregion representing a particular geomorphological process but containing several distinctive types of catenary sequence. Examples would be upper slopes, scarps, foothills and pediments within an escarpment subregion; hills and plains within a plateau subregion, and calderas, cones, slopes and pediments within a volcanic massif subregion.

IV **Land Unit =**
Land System: A local variant within a land area on the basis of geology, soils and drainage pattern, containing a single type of catenary sequence; strong correlations with vegetation, animal use and human use are expected. Examples are the land systems depicted by Astle, *et al.* (1969) for the Luangwa Valley, i.e., meander belt, escarpment foot, etc., or the land units of McShane (1984) for Vwaza, for example subdividing pediments into a set of different types.

V **Land Facet:**   A component of the catenary sequence within a land unit, for example ridge top, valley slope, valley floor, etc.

VI **Land Element:**   An individual item within a land facet, such as a rock outcrop, sandbank, dune, gully, etc.

We repeat that we realize that this set of category definitions is to a large extent arbitrary and not always easy to apply. Of course it is not always necessary to use all the above listed levels of classification. For most conservation areas, the levels of land area, unit and facet are probably the most useful, with the regional and subregional levels useful for placing the area in a wider context.

6.   THE SOIL CATENA AND OTHER PHYSICAL VARIABLES:

In the above classification, each category and level of categories is defined in terms of physical variables, geomorphology, topography, soils and climate.   This is a set of more or less interdependent variables with geomorphology and climate being the primary semi-independent determinants. These two are of course interrelated, both in that geomorphology influences climate through altitudinal and orogenic effects (although latitude, continental situation and other factors introduce considerable variation) and in that climate influences geomorphological processes such as deposition, erosion and weathering (see Chapter 9).

The definition of landscape categories, particularly at the area, unit and facet levels, is closely tied up with the concept of the soil catena, formulated by Milne (1935) and summarized by Young (1976), as follows: a catena is a succession of soils down a slope, usually extending from interfluve crest or hilltop to valley floor.   Water and soil components move laterally down the slope so that on each part of the slope, a particular set of conditions for weathering, erosion, leaching and deposition prevails, resulting in the development of a particular type of soil profile at each part of the slope.   The primary division of most catenas is into a freely drained upper part and a poorly drained lower part, the former usually occupying most of the slope.   The freely drained part may be divided into a crest section and a slope section; the poorly drained part may be divided into a valley margin section and a valley center section.   These sections correspond to land facets.

In the facet, we have the basic ecological unit with relatively uniform soil type, slope and rainfall.   As Martin and Taylor (1983) have pointed out, if these three physical factors are known, most of the biological and agricultural features can be predicted.   In an area of relatively uniform geology, topography and climate, the characteristic soil catena may be repeated on each undulation over large areas.   It is this repetition of the catenary soil series, with the vegetation, fauna and land use associated with it, that forms the basis of the concept of the land system and the system of landscape classification built on it.

7.   VEGETATION, LANDFORM AND CLIMATE:

The correlation between soil types and vegetation is of course well known, and is often so close that vegetation types are used as indicators of soil types, both in identifying catena sections (land facets) and in identifying whole catenary sequences (land units or systems).   This is particularly true when using aerial photographs or satellite imagery; in such cases, vegetation cover and topography are the two primary sources of information available.   A long series of papers by Monica Cole has emphasized the association between vegetation and geomorphology on the regional scale (i.e., Cole 1963 and 1982) and has exploited vegetation patterns as indicators of geomorphological and mineral features (i.e., Cole 1968 and 1971).

For these reasons, vegetation maps and landscape classification maps are often very similar. However, they are not identical, usually for two types of reasons:

Firstly, the correspondence between landform and vegetation may be radically altered by human activity. Secondly, certain vegetation types may occur over a wide range of physical conditions. For example, *Brachystegia* woodland on plateaus may differ very little in floral composition from *Brachystegia* woodland on escarpments, so that on purely floral grounds, two areas might fall into the same category, while in terms of landscape classification they would fall into different land regions. This fact is frequently recognized in vegetation maps which extend their range of applications by incorporating into the legend some subclassification on the basis of geomorphological situation, e.g., Mopane on clay; Mopane on sodic flats; e.g., Acocks (1975).

8.   FAUNA LANDFORM AND CLIMATE:

Continuing to the correlations of fauna with landform and climate, herbivores are related to vegetation which in turn is related to these physical variables. It is therefore self-evident that herbivores are correlated with landform and climate. However, such correlations have begun to be overtly recognized relatively recently. On the climatic side, Watson (1972) originated the idea that herbivore biomass is correlated with rainfall; this idea was elaborated by Coe, Cumming and Phillipson (1976). On the landform side, Bell (1969, 1970, 1971) demonstrated the seasonal association between different herbivores and different catena levels (land facets) and between different faunal associations and different catenary sequences (land units and areas) in the Serengeti National Park, Tanzania. Later, Bell (1982) emphasized the association between herbivore communities (i.e., species composition, biomass and productivity) and physical variables on the regional level including geomorphology, soils and rainfall, arguing that a series of curves exists relating herbivore biomass to rainfall, each curve being characteristic of a particular geomorphological situation. Parker (1984) has analyzed in more detail the correlation between elephant density, geomorphology and rainfall at the regional level. Finally, Bell (1981a, 1981b, and 1982) has argued that many dynamic aspects of ecosystem function are associated with landform and climate, through the influence of soil nutrients and soil water dynamics on the quantity and quality of plant production and hence on the densities of herbivores and on the timing and intensity of fires and the consequent impact of herbivores and fire on the vegetation and on each other. Bell (1981b) has argued that ecosystem stability is related to landform, communities in fertile landscapes being inherently less stable ecologically than those infertile landscapes (see Chapter 9). Lewis (unpublished) has reached similar conclusions from studies in the Luangwa Valley, Zambia.

9.   HUMAN USE, LANDFORM AND CLIMATE:

It is equally self-evident and well known that human densities, cultures and land use practices are related to climate and landform. Watson (1972) showed that livestock densities are partially correlated with rainfall. Bell (1982a) showed that both human and livestock densities are related to rainfall and geomorphology in a way similar to large herbivore biomasses, while Parker (1984) has analyzed the relationship between human densities, rainfall and geology in more detail.

Cultural relationships are also evident. Pastoral societies are found in the drier, more fertile areas, cultivating societies in the moister less fertile areas, while the moist and fertile areas support dense populations of mixed farmers with crops and cattle. Similarly, Crossley (1984) has pointed out that the density and life style of the people surrounding Lake Malawi are related to escarpment type: steep down-throw faults produce a narrow lakeshore plain with little alluvial accumulation (providing limited agricultural potential) and a steeply shelving lake bottom with oligotrophic water since incoming nutrients are trapped below the thermocline (providing limited fishing potential). The people are therefore sparse and subsist on low quality cultivation (mainly cassava). Gentle monoclinal escarpments, by contrast, provide wide alluvial lakeshore plains and wide, shallow, nutrient-rich lake margins. The populations are dense and affluent, with productive fisheries, agriculture and livestock.

Bell (1982b, 1984a, and Chapter 22) has pointed out that many forms of interaction between humans and wildlife are related to landform. Subsistence cultivators in Malawi tend to be the heaviest poachers, while cash crop farmers and fishing communities are less involved in such activities. One may generalize by saying that communities living in landscapes where domestic production is difficult (i.e., semideserts, moist oligotrophic savanna woodland and rain forest) tend to rely heavily on wildlife resources where protein production is limited. The communities of West African rain forest for example, are noted for their reliance on bushmeat, including even crocodile meat which in most areas is considered inedible (Bell 1984b).

The association between landform and climate with developed livestock and farming systems and agroindustry is of course equally self-evident. What is perhaps more surprising is the extent to which this association is ignored in land use planning in Africa, an omission emphasized, for example, by Hunter (1981) among others.

In this the fault lies usually with externally based development agencies which have neither the time nor the expertise to carry out appropriate land capability surveys and develop appropriate land use systems. As both Hunter (1981) and Martin and Taylor (1982) have pointed out, individual farmers who carry the economic risks, are frequently well in advance of economic planners who carry no risks, in their evaluations of landscape potentials.

Finally, strong correlations exist between landform and climate and the potential, problems and costs of infrastructure development; in fact the original development of landscape classification systems received a large input from military and civil engineers (Brink, *et al.* 1966; Christian and Stewart 1968). Particularly relevant to wildlife management is road development, the ease and costs of which are clearly related to landform and climate. Bell and Mphande (1980), for example, used a landscape classification of Vwaza Marsh Game Reserve, Malawi, as the basis for planning a road network for the reserve; the landscape classification indicated both the needs from the point of view of tourism and management of each area for road access and the problems and costs of installing it.

10. CONCLUSION--LANDSCAPE CATEGORIES AS THE FUNCTIONAL UNITS OF LAND USE PLANNING:

The relations and interactions between the various physical and biological components of ecosystems will be examined in more detail in Chapter 9 (soil-plant-herbivore interactions). For the moment, suffice it to say that very many aspects of ecosystem structure, dynamics and utilization are site specific, that is, they are related to particular aspects of the environment, notably geomorphology, topography, soils and climate. That being so, a first requirement in planning and managing any area of land is to produce a description of its physical resources to which the biological resources and utilization potential can be causally related.

Landscape classification provides a framework for such a description. Each landscape category is defined in terms of its physical features in relation to which the associated biological features, vegetation and animal and human use may be catalogued. These associations between physical and biological features may then form the basis of predictive hypotheses about each landscape category, concerning for example, its wildlife carrying capacity or its agricultural potential. The landscape categories may then be used as a stratification framework for testing these hypotheses. Finally, insofar as the hypotheses are valid, each landscape category may be regarded as a functional unit of the ecosystem, the resources of which are known within known limits, and the dynamics and hence management requirements and utilization potential of which can be predicted.

Within the sphere of wildlife management, the landscape classification should provide the basis for predicting the carrying capacity, and species composition of large herbivores, and hence the potential for tourism, culling, safari hunting, traditional hunting and other uses; the likely type of impact of animals and fire on the vegetation and hence the need for ecological management; the scenic value and the costs of infrastructure development; and the potential for agriculture and livestock and hence the likely degree of conflict with other types of land use.

In conclusion, landscape classification should be the first step in any process of land use. It provides the information necessary to select goals for an area; it provides the logical framework for improving understanding of ecosystem function and hence management potential, it provides the functional units within which to carry out practical management and utilization regimes, and it provides the framework for feeding back information on those regimes. As such, the landscape categories provide the functional units of adaptive management. Their definitions, associated features and predicted potentials may change with improved understanding, while their boundaries may be altered as a result of improved surveys. However, at any one time, they should contain an integrated summary of the technical information on the area, and as such, as Gertenback (1983) has emphasized, they should not be negotiable on the grounds of policy.

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CHAPTER 8

SOIL-PLANT-HERBIVORE INTERACTIONS

BY

R.H.V. BELL

1. INTRODUCTION:

Soils, plants and herbivores exist in a complex set of interactive relationships which lie at the center of most aspects of ecological management in African ecosystems. The purpose of this paper is to provide a brief review of these interactions as they are currently understood.

The central link is the quantity, quality, structure and productivity of the vegetation. On the one hand, these features are determined by the physical environment, particularly soils, slope and climate. On the other hand, they determine the quantity, type and productivity of the herbivores using the vegetation. In turn, the herbivores constitute a major influence on the vegetation, so that the soil-plant-herbivore interaction contains an important feedback loop as follows:
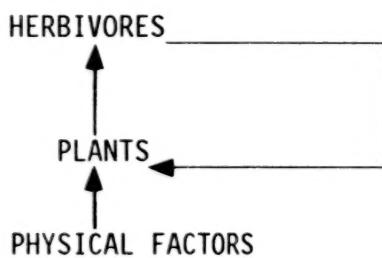
Soil-plant-herbivore interactions take place on three main time scales:

Firstly, the short-term interactions involving seasonal rainfall cycles, changes of soil moisture and in which plants and herbivores influence each other's biomass;

Secondly, the medium-term interactions, involving periodic climatic cycles, in which soil properties such as infiltration rate and nutrient status may change and in which plants and herbivores influence each other's species composition; and

Thirdly, the long-term or evolutionary interactions, involving major climatic shifts, geomorphological processes and in which plants and herbivores influence each other's genetic constitutions;

In wildlife management, we are usually concerned with the short and medium-term interactions, although some geomorphological processes, i.e., erosion, and some genetic changes, particularly due to reduced population size (Frankel and Soule 1981) may occur rapidly enough to warrant attention. Primary management concerns related to soil-plant-herbivore interactions are as follows:

a. Soil processes (erosion, siltation, leaching, etc.) may be accelerated by reduction of plant biomass by herbivores, and may cause changes in vegetation and animal distributions and densities;

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b.   Water availability in catchments may be influenced by reduction
          of plant cover by herbivores;

   c.   The food supplies of herbivores themselves (either of the same or
          other species) may be influenced by herbivore use;

   d.   Landscape aesthetics may be influenced by soil processes and
          modification of vegetation by herbivores; and

   e.   Soil-plant-herbivore interactions determine herbivore carrying
          capacities and hence the potential for consumptive and non-
          consumptive uses.

2.   PLANT-HERBIVORE INTERACTION MODELS:

   No comprehensive model of soil-plant-herbivore interactions has yet
been developed, so that currently one has to work with plant-herbivore
interaction models, plugging in values for vegetation parameters
appropriate to particular soils and climates.

   An introduction to models of plant-herbivore interactions is given by
Caughley (1976). Caughley discusses the various possible outcomes of
fairly simple Lotka-Volterra type interactive models and concludes that
they are of three types:

   a.   Extinction of one or both trophic levels;

   b.   Stable limit cycles or continuous oscillations of both trophic
          levels; and

   c.   Equilibria between trophic levels.

   Caughley defines the conditions that lead to each type of outcome.
The most important conditions leading to oscillatory or unstable
interactions are:

   a.   High levels of usable plant biomass;

   b.   High ratios of usable to unusable plant biomass; and

   c.   Slow responses of both plant and herbivore biomasses to
          reductions in plant biomass.

   Stable equilibria result from conditions of low usable plant biomass,
low ratios of usable to unusable plant biomass, and rapid responses by both
plants and animals to reductions in plant biomass.

   A variety of plant-herbivore interactive models have been developed,
but they all have basically the same features. The key point to recognize
is that one of the principal factors that determines whether a plant-
herbivore system will be stable or not is *the quality of the food supply as
perceived by the herbivore*. Situations with high quality food supplies are
more likely to be unstable than food supplies which contain a high
proportion of low quality material that cannot be used by herbivores.

What we need to do now is to try to link the Caughley-type plant-herbivore interactive model to external environmental factors so that we can predict the outcome in different sets of conditions. Ultimately, the objective will be to develop a "unified field theory" that will set the appropriate parameter values in the plant-herbivore model on the basis of external conditions, particularly soils, slope and climate on the one hand and predation and dispersal on the other. The following sections will summarize some of the factors that may be involved.

3.   VEGETATION QUALITY:

The importance of vegetation quality in determining system stability was emphasized above. Let us be quite clear what is meant by the term quality:

Plant material is made up of a range of constituents or components. Some components are usable by herbivores, others are not. Usable components include proteins, soluble carbohydrates fats, etc., and are mainly constituents of plant cell contents, (Bell 1971, 1982). Components which are unusable or usable slowly include cellulose and lignin, the main constituents of fibre; they are primarily structural constituents of the plant cell wall, and in fact make up the great majority of plant material (Bell 1971, 1972). There is also a set of plant components that is actively inhibitory to use by herbivores; this is the group of plant chemical defenses known as secondary compounds, (Freeland and Janzen 1974).

Plant quality is determined by the relative proportions of usable, unusable and inhibitory components. A useful first level indicator is the protein-fibre ratio, or the cell-content to cell-wall ratio, or what Bell (1982) has called the M/C ratio (metabolite/cell wall ratio). The profound importance of plant quality defined in this way to use by herbivores has been emphasized by Bell (1969, 1970, 1971, 1982), Janis (1976), Owen-Smith (1982 and, in press), Foose (1982) and Demment and van Soest (1983) among others.

In these terms, the great majority of plant material is of poor quality and unusable from the point of view of mammalian herbivores. As Bell (1971) put it: the primary problem confronting the herbivore is that of extracting sufficient protein (and energy, Owen-Smith, in press) from a diet containing superabundant and obstructive carbohydrate.

Plant chemical defenses are probably at least as important in determining vegetation quality, but their significance has been recognized only relatively recently and very little work in this field has been carried out in relation to large African herbivores. At present we have to rely mainly on inferences from work in other continents (mainly the Americas) with insects and smaller mammalian herbivores (see Freeland and Janzen 1974 and Bryant, *et al*. 1980 and 1983 for reviews). Briefly there is a considerable range of plant secondary chemical defenses, including tannins, phenolics and hydrocyanins. Their concentrations vary between species, between plant parts and growth stages, grasses having less of this form of defense than dicotyledons. In some cases at least, secondary chemicals can be rapidly mobilized in response to browsing or disturbance of the plant by herbivores (Baldwin and Schultz 1983; Van Hover 1984).

4.   FACTORS CONTROLLING SOIL WATER AND SOIL NUTRIENT AVAILABILITY:

The argument put forward in this paper is that the absolute and relative production of the various plant components, and hence the quantity and quality of the vegetation, are determined by the physical inputs (the availability of water and nutrients at different levels of the soil) on the one hand and biological influences (interactions with other plants and off-take by herbivores) on the other. Here we consider the physical inputs.

In considering the availability of water and nutrients to plants, it is useful to distinguish between the "topsoil," the upper 30 cm of soil, in which most grass roots but relatively few tree roots are located, and the "subsoil," the soil below 30 cm depth, in which there are few grass roots but the majority of tree roots occur (Walter 1971; Walter and Noy-Meir 1983). There is wide variation in the depth to which tree roots penetrate; however, most probably do not descend below about 15 m. Beyond this depth, water and nutrients are unavailable to plants; one may term this zone the "undersoil."

The four main factors determining water availability at different levels of the soil are soil type, slope, climate and vegetation. Their effects may be summarized as follows:

a.   Soil Type:

For any one situation, the soil water content at any level of the soil is a function both of the ability of that layer to retain water and the ability of the layers above and below it to transmit water. Low transmission rates (low penetrability and high retention) of a layer and the layers below it tend to raise water content; low transmission rates of layers above it tend to reduce water content. Transmission rates of water through soil are highly correlated (inversely) with clay content. Thus soils with higher clay contents tend to reach higher water contents throughout the profile and remain moist much longer than sandy soils, although penetration to lower levels may be slow (Walter 1971; Bell, unpublished data), so that, in low rainfall areas, lower soil levels remain dry (Goodman, unpublished data). In sandy soils, rainwater penetrates rapidly through the profile, producing a sharp water content peak which descends through the profile leaving conditions of relative drought in the topsoil (Bell, unpublished data). However, it must be recalled that water availability to plants is not directly related to water content, since the ability of clays to bind moisture is much greater than that of sands. Thus, while wet season water availability in clay soils is usually relatively high, dry season availability may be relatively low, so that clay soils tend to support vegetation types characteristic of drier areas on sandy soils (Walter 1971). Other features which affect water penetration are calcareous, silicaceous or lateritic hardpans, which, if occurring at depth may create subsoil water tables, or if shallow may greatly reduce water penetration beyond the topsoil, as on the Serengeti plains (de Wit 1981; Jager 1982). In sandy soils, the persistence of moisture in the profile depends on the presence of an impermeable layer of rock, clay or hardpan; without one of these, water passes through the topsoil and subsoil into the undersoil, where it is unavailable to most plants. Such deep sandy soils are relatively arid and are described as "overdrained" (Tinley 1982). In

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certain high clay content soils, the opposite effect may occur (Tinley 1982; Walker, personal communication). Here high water retention may lead to a waterlogged anaerobic soil layer, known as a "glei" layer. Such a layer (which may only be anaerobic for a few days in the year) is an effective barrier to root growth and thus renders both water and nutrients in and below it unavailable. Such soils are thus generally unsuited to tree growth and usually support some form of grassland, including the typical hydromorphic grasslands of toich, mbuga, dambo and vlei, as well, Tinley (1982) argues, as upland grasslands as on the tropical mountains and the Transvaal highveld.

b. Slope:

Soil water dynamics are affected both by the slope of the soil surface and of the various layers of the profile, and by the topographic situation of the site in relation to slopes elsewhere, that is, to the situation in the soil catena (Young 1972, 1976). Very briefly, in sites near catena peaks and with steeper slopes, relatively little of the incident rainfall penetrates the soil profile, while in sites near catena sumps and with shallow slopes, more water penetrates the profile, other factors being equal. Thus soils in steep terrain tend to be drier than in flat terrain, except in valley floors.

c. Climate:

The influence of rainfall on soil water availability is well-known. A variety of factors affect the "efficiency" of rainfall, that is, the proportion of incident rainfall that becomes available to plants in the soil. Soil type and slope have been discussed above; other aspects of climate affecting rainfall efficiency are temperature, wind and vegetation cover, through their effect on evapotranspiration (Walter 1971); rainfall is less efficient in hotter and windier conditions. Equally, intense precipitation is less efficient than light precipitation because of the higher proportion lost as runoff (Jager 1982), while Western (unpublished) suggests that bimodal rainfall patterns may be less efficient than unimodal rainfall regimes. It should also be emphasized that the between year variation in rainfall is an inverse function of total rainfall, drier areas experiencing greater variation than wetter areas (Walter 1971; Sinclair and Norton-Griffiths 1979).

d. Vegetation:

Vegetation affects soil water availability in three ways: firstly, by intercepting rain before reaching the soil surface, secondly, by influencing runoff and evaporation from the surface, and thirdly, by capturing and removing it from the soil by transpiration. While it is generally assumed that woody cover increases soil water availability and is hence beneficial to water catchments, there seems to be little experimental evidence that a simple generalization can be made. Various aspects of the question are discussed by Walter (1971), Walker and Noy-Meir (1982) and Tinley (1982) among others. While a woody canopy intercepts rainfall, the majority probably reaches the ground (except perhaps in evergreen forest), much of it by means of branch and stem flow, which may in turn provide a favored route for water to reach the subsoil. Similarly a canopy shades the soil

surface, reduces evaporation and transpiration and increases infiltration through litter, so that subcanopy sites have higher moisture contents, particularly in the dry season. By contrast, treeless sites frequently show a hard soil crust with algal capping which impedes water infiltration. Thus, there seems to be general agreement that woody cover may increase the efficiency of rainfall in entering the soil. What is less clear is whether this effect is outweighed by the pumping action of root systems and evapotranspiration. The authors cited above suggest that, in semiarid conditions, a dense grass root-mat may intercept the majority of water in the topsoil, thus preventing sufficient to reach the subsoil to allow tree growth. On the other hand, once established, trees may impede grass growth by shading and rain interception and stem flow, and by removing hydro-morphic soil conditions by root pumping. Thus, in soils of intermediate permeability which do not overwhelmingly favor tree growth (high infiltration) or grass growth (low infiltration), plant communities may show alternative stable states dominated by woodland and grassland respectively, which can be switched back and forth by defoliation of the dominant plant layer.

Turning to soil nutrient availability, the situation is more complex in that over 25 different chemical elements are involved and a wide range of compounds (Merz 1981). However, some broad generalizations are possible. Firstly, with the exception of a few of gaseous origin, most nutrients are ultimately derived by weathering from parent geology. Secondly, again with some important exceptions (i.e., certain compounds of phosphorous and sulfur) most nutrients are more or less soluble and hence mobile in the soil solution, thus tending to gravitate out of elevated situations towards lower situations and to accumulate in sumps and evaporation sites. Thus, nutrients may reach a particular location either directly by weathering from parent rock, or by transport as alluvium or colluvium, or in solution. Nutrients may equally be transported away from their weathering site by the same means.

To summarize, then, soil nutrient availability at a point is deter-mined by the quality of the parent geology, by the rate of weathering, and by the transport of material into and out of the area by water transport. Rock types rich in nutrients include basic igneous rocks (i.e., basalts, dolerites, gabbros, etc.) and sedimentary rocks derived from organic or fine alluvial deposits (i.e., limestones, shales, mudstones, siltstones, etc.) The East African basic volcanics produce some of the most fertile soils on earth. Rock types poor in nutrients include acid igneous rocks (andesites, granites) and sedimentary rocks derived from coarse alluvial fractions (i.e., gneisses, sandstones, quartzite, etc.) The precambrian metamorphic rocks of the central African basement produce generally poor soils.

An important set of weathering products from nutrient-rich rocks is that of the clay minerals. These are minerals based on silicon lattices with exchangeable cations (i.e., K, Na, Ca, Mg, etc.) inserted within the lattice structure. The density of sites in the lattice capable of accepting such cations (The Cation Exchange Capacity) together with the proportion of such sites actually occupied (The Base Saturation), give a useful overall index of soil fertility, which is thus generally positively correlated with clay content. By contrast, quartz (i.e., silica, the oxide

of silicon) is the primary weathering product of nutrient-poor rocks, and is the main constituent of sand. The clay particles, being much smaller than sand particles, are more easily transported by water, and are thus more prone to leaching, forming the fine alluvial fractions as opposed to the coarse fractions of silt and sand, which tend to remain closer to the weathering site.

The rate of weathering is a function of water availability and temperature (Thomas 1975), being faster in wet, warm situations than dry cool ones. Soil depth is determined by the balance between weathering (deepening the soil at its base), deposition (deepening the soil at its surface) and erosion (removing soil from the surface). Thus soils are usually deeper in flat areas since they are wetter, weathering is faster, and deposition may exceed erosion. In sloping areas, soil profiles are drier, weathering is slower and erosion may exceed deposition. Soil quality is usually poorer in deeper soils on flat areas since the older soil profile is more exposed to leaching (unless the areas is subject to high quality alluviation); soils on slopes are shallower but generally of higher quality since the soil surface is kept closer to the weathering zone by removal of the surface by erosion; the profile is therefore younger; the danger here is that it may be removed altogether if erosion consistently exceeds weathering.

The quality of the soil is inversely related to rainfall (Young 1976). This is because higher rainfall results in greater quantities of water passing through the soil, thus removing the more mobile fractions by leaching. Indeed, there is a critical point between about 500-700 mm rainfall per year (Tinley 1982) below which water does not pass right through the soil profile, and nutrients accumulate within the profile, and above which soils become freely draining and continuously lose nutrients. This inverse correlation between rainfall and soil nutrient availability is the basis for the distinction between the moist-oligotrophic savannas and the arid-eutrophic savannas (cf., Huntley 1982). Note, however, that the correlation can be overridden by other factors, such as parent geology, so that, for example, some "arid-eutrophic" savannas are not in fact arid; the western Serengeti is a case in point.

Soil nutrient availability tends also to be highly correlated with water permeability (inversely) since both are related to clay content and to other forms of concretion (i.e., calcrete and ferricrete). Thus permeable soils (with high infiltration rates of water) are usually sandy with low cation exchange capacities, while impermeable soils (with low infiltration rates) usually have a high clay content or some other mineral concretion and have high cation exchange capacities. There are, however, exceptions to this rule. Certain clay minerals (notably kaolinite and gibbsite) derived from acidic rocks are relatively nutrient-poor and may produce impermeable soils of low fertility, especially where high rainfall leads to low base saturation levels. Some high altitude grassland soils on basement geology are of this type (i.e., Nyika plateau, Malawi). Alternatively, certain well-drained silty and sandy soils may have high nutrient status, either through weathering of basic sand particles or through permeation by nutrient rich ground water. The former type is found in certain sand dune soils in Natal (Goodman, unpublished data), the latter in areas of internal drainage in Kalahari sands (Jager, unpublished data).

Finally, it is often assumed that biological communities may act as significant reserves of nutrients which are protected from loss from water transport. This factor is thought to be particularly important in areas of low nutrient status and high leaching rates. It is believed, in consequence, that in such situations, removal of the community by tree felling or animal culling can lead to reduction of the overall nutrient status. While this is a reasonable hypothesis, there is little real evidence relevant to the question, and it is still best treated as a hypothesis.

We may conclude by making a list of guidelines as to the factors determining the availability of water and nutrients in the soil; these are not rules, and exceptions to most can be found.

Soil water availability is higher in higher rainfall and cooler areas, in flat areas and in valley bottoms. High clay content soils have low infiltration rates and retain more moisture near the surface; they are resistant to lateral flow and may be arid in the dry season. Sandy soils have high infiltration rates and allow rapid water percolation to depth; they do, however, allow lateral flow and water may become available in the dry season in this way.

Soil nutrient availability is higher in areas of basic geology and fine alluviation; nutrient availability is positively correlated with clay content and therefore often inversely correlated with water infiltration rate. Soil fertility is reduced by high rainfall. Soils in flat areas tend to be deeper, sandier and less fertile except where affected by alluviation. Soils on slopes tend to be shallower, more clayey and more fertile.

The controlling factors of geology, slope and climate can occur in a wide variety of combinations leading to the great diversity of African ecological community structure. However, certain clear syndromes emerge, related to broad geomorphological situation (Bell 1982). A major contrast exists, for example, between the arid-eutrophic savannas of the eastern African rift system with its basic geology and its active, uneven topography, leading to nutrient-rich but moisture-poor soils, and the moist oligotrophic savannas of the basement plateau areas with their acid geology and dormant flat landscapes, leading to deeper sandy soils with low nutrient status but higher moisture availability, particularly in the subsoils.

5. THE INFLUENCE OF SOILS AND RAINFALL ON PLANT BIOMASS AND QUALITY:

Soil properties and rainfall have dominant effects on plant-herbivore interactions since the absolute and relative production of the various plant components that is, plant biomass and quality, are largely determined by the balance between soil nutrient and soil water availability (Bell 1981a, 1982).

Taking first of all the effect of rainfall alone on total plant production, Rutherford (1978) has reviewed production data from Southern Africa and showed strong positive correlations between annual rainfall and herbaceous production within any one soil/vegetation type. However, these data show important differences between soil/vegetation types. The low

production curves are from vegetation growing on basement geology and/or low nutrient status soils, whereas the high production curves are from vegetation on sedimentary or basic geology and nutrient-rich soils. These data therefore demonstrate that total plant production is strongly correlated with both water availability (rainfall) and soil nutrient availability. To assert, as do Hilborn and Sinclair (1979), that grass production in the Serengeti depends solely on rainfall, is, of course, incorrect.

Turning now to plant quality, the question is, if total production is stimulated by water and nutrient availability, how is that extra production partitioned between usable, unusable and inhibitory components? There are very few data relevant to this point available. However, Grimsdell and Bell (1975) showed that in Zambian floodplain grasslands, total production and protein production were both positively correlated with soil fertility (cation exchange capacity), but that the gradient for protein was steeper than the gradient for total production, so that the protein-fibre ratio was itself positively correlated with C.E.C., i.e., plant quality was positively correlated with soil fertility. In *Brachystegia* woodland in Malawi, Bell (1981) showed that in sandy soils with high infiltration rates and low cation exchange capacity, water and nutrient availability in the top soil were both low, leading to a low biomass of relatively high quality grass (i.e., protein production was low but not heavily diluted by fibre production). By contrast in clay-loam soils with lower infiltration rates and high cation exchange capacities, water and nutrient availability in the topsoil were both high, leading to a high biomass, of relatively low quality grass (i.e., protein production was high but heavily diluted by fibre production). At the other end of the scale, poor quality "sour" grasslands are associated with infertile soils, while high rainfall areas tend to be dominated by unusable tall woodland and forest (cf., Parker 1984).

One may conclude by postulating (cf., Bell 1981) that high water availability (due to high rainfall and/or highwater infiltration rates into soil) favors production of both protein and fibre, but preferentially fibre, tending to reduce vegetation quality. High soil nutrient availability favors production of protein and fibre, but preferentially, protein, tending to increase vegetation quality. Thus, the moist-oligotrophic savannas tend to have a high biomass of low quality vegetation, while the arid-eutrophic savannas tend to have a low biomass of high quality vegetation.

This contrast is exaggerated by the distribution of secondary chemical defenses, which tend to be more prevalent in plants growing on low nutrient status soils (Janzen 1974, McKey, *et al.* 1978, Bell 1982). This tendency reduces plant quality in infertile areas still further.

We may, therefore, summarize the influence of soils on plant biomass and quality as follows: (See Bell 1984)

HIGH

SOIL
WATER
INFILTRATION
RATE

LOW

	LOW SOIL NUTRIENTS	HIGH
	High plant biomass Low quality (Kasungu, W)	High plant biomass High quality (Luangwa, Umfolozi)

	Low plant biomass
	Low quality
	(Nyika, Sehlaba
	  Thebe)
		Low plant biomass
		High quality
		(Serengeti,
		  Amboseli)

LOW   SOIL NUTRIENTS   HIGH

The effect of increasing rainfall is generally to move the horizontal line down and the vertical line to the right, that is, to increase the domain of the moist-oligotrophic syndrome by increasing fibre production relative to protein and increasing secondary chemical defense, that is increasing plant biomass but reducing quality.

We may predict, therefore, that areas with low soil nutrient availability, high infiltration rates and high rainfall (moist-oligotrophic) will tend to support stable plant-herbivore interactions, while areas with high soil nutrient availability, low infiltration rates and low rainfall (arid-eutrophic) will tend to support oscillatory or unstable communities. This tendency will be exaggerated by the relative variability of rainfall in lower rainfall areas, (Sinclair and Norton-Griffiths 1979).

6. THE BALANCE BETWEEN GRASS AND TREES:

The balance between the biomass of grass and the biomass of trees is influenced by the relative availability of water at different levels of the soil (Walter 1971; Walker and Noy-Meir 1982); Bell 1981a). Tree biomass is favored in high infiltration rate soils, with relatively more water available in the subsoil than the topsoil. Grass biomass is favored in low infiltration rate soils with relatively high water availability in the topsoil. Very impenetrable soils support treeless short grasslands, as in the Serengeti (Jager 1980), or montane grassland (Tinley 1982).

We may again summarize the situation as follows:

```
HIGH          │                    │
              │  Poor quality      │  High quality
              │  woodland          │  woodland
SOIL          │  (Kasungu, W)      │  (Luangwa)
WATER         │                    │
INFILTRATION  │_____│_____
RATE          │                    │
              │                    │
              │  Poor quality      │  High quality
              │  grassland         │  grassland
              │  (Nyika)           │  (Serengeti)
LOW           │_____│_____

        LOW              SOIL NUTRIENTS           HIGH
```

Increasing rainfall again shifts the lines down and to the right, that is, increasing the predominance of woodland and reducing vegetation quality.

7.   THE FEEDING ECOLOGY OF AFRICAN UNGULATES:

Each herbivore species performs differently in relation to the biomass, quality and structure of the vegetation, that is, the density and spacing of the plant components in each quality class.   Herbivore performance depends on body size, digestive physiology and the structure of the body and feeding mechanism (Bell 1969, 1970, 1971; Janis 1976; Owen-Smith 1982; Foose 1983; Demment and Van Soest 1983; Owen-Smith, in press). The two major factors to be considered here are body size and digestive physiology.

The key factor in the feeding ecology of herbivores is the tolerance range of the animal, that is, the range of food quantity and quality over which the animal can survive.   Most herbivores select for similar diets, that is green leafy material of high quality; where they differ is in their ability to tolerate diets that depart from this (Bell 1969, 1971).   This discussion will therefore be in terms of tolerance rather than selectivity.

Firstly, the tolerance of low quality plant material (low protein-fibre ratio) in the diet increases with increasing body size, because large animals have relatively low metabolic rates and maintenance requirements per unit weight (Bell 1969, 1970, 1971), and because lower quality foods require relatively large gut volumes, a requirement exaggerated in small animals by their high relative maintenance requirements, leading to impracticable gut-body volume ratios in small tolerant herbivores (Owen-Smith, in press) which therefore, do not exist.

Secondly, dietary tolerance varies in relation to the structure and physiology of the digestive system.   Among African ungulates, the primary distinction is between the ruminants (cloven-hoofed animals, i.e., cattle,

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antelopes, pigs, etc.) which ferment plant fibre in the complex multi-chambered foregut, and the nonruminants (a mixed group including the elephant, rhino, and zebras) which have simple stomachs and ferment plant fibre in the hindgut and caecum. The ruminant group has a much higher digestive efficiency, that is, ability to extract protein, etc., from plant food than the nonruminants, but do so by means of delayed passage of food through the rumen, the delay increasing as food quality falls. The nonruminants, by contrast, process food rapidly and relatively inefficiently, the rate of passage being unaffected by quality. The result is that, while ruminants are more efficient than nonruminants on high quality foods and outcompete them, their performance falls off sharply as the fibre content of the food rises, to the extent that they cannot maintain themselves, whereas the nonruminants continue to do so by processing large quantities of low quality food (Bell 1969, 1970, 1971; Foose 1982).

Taking body size and digestive strategy together, African ungulates present a wide spectrum from very small ruminants which are strongly selective of small quantities of high quality components of the vegetation and have very narrow dietary tolerances, to very large nonruminants which require large quantities but can tolerate a wide range of relatively low quality plant components (Bell 1969, 1970, 1971). Owen-Smith (in press) has pointed out that, of the five African megaherbivore species (animals exceeding 1000 Kg in adult body mass), four are nonruminants, i.e., elephant, the rhinos, and hippo, the exception being giraffe. (The hippo has a unique digestive system with a complex foregut, very low passage rates of food and moderate digestive efficiency, see Foose 1982. Foose suggests that it maintains itself as a result of the low metabolic rate and maintenance requirement allowed by its aquatic habit).

Since smaller herbivores, particularly ruminants, are obliged to select high quality vegetation components, their rate of food intake is reduced by the presence of much fibrous or woody material which obstructs access to high quality items. Such species are thus sensitive to details of vegetation structure and show a range of adaptations of body shape and tooth and jaw structure in response. Bell (1969) has argued that this restricted tolerance in feeding ecology is the reason for the much wider range of adaptive radiation among bovids (ruminants) than among the nonruminant ungulates.

A further consequence of the sensitivity of smaller ruminants to vegetation structures, for example their poor performance in tall grass, is that in certain circumstances they depend on fire, man, or other herbivores to open up the vegetation for them to allow access to high quality components. This is a short-term plant-herbivore interaction known as the grazing succession, (Vesey-Fitzgerald 1960; Bell 1969, 1970, 1971), in which herbivores can facilitate each other's feeding rather than interfere with it through competition. The larger nonruminants tend to form the active leaders in grazing successions because of their wide tolerance of stemmy and woody material and their need to maintain high rates of intake (Bell 1971). The applicability of the facilitation hypothesis is subject to dispute, however (Sinclair and Norton-Griffiths 1982).

The ability of different types of African herbivore to tolerate plant secondary chemical defenses is not clear. Janis (1976) and Barnes (1982) have suggested that nonruminants may have wider tolerance than ruminants, but Owen-Smith (1982) has pointed out that the evidence is slim and circumstantial at best and that the point should be left open pending further investigation.

One may predict on the basis of the feeding ecology of African ungulates that species with wide tolerance of dietary quality (i.e., mainly the larger species, particularly the nonruminants) will tend to produce unstable or oscillatory plant-herbivore interactions, for four reasons.

Firstly, because their wide dietary tolerance, they are capable of using a higher proportion of the vegetation and so leave a smaller unusable reserve. In the case of elephant, particularly, even woody tree trunks are not immune and are pushed over without being eaten. Secondly, the larger species are less vulnerable to environmental fluctuations; because their dietary tolerance is high, they are better able to wait out dry spells than more selective species, using very poor quality material. Thirdly, they are less vulnerable than small animals to predation; Owen-Smith (in press) has emphasized the importance of this factor in removing the damping influence of predation from plant-herbivore interactions. Finally, since reproductive rates are inversely scaled to body size (Western 1979; Owen-Smith, in press, Chapter 12), populations of larger species cannot respond as rapidly to improved conditions by rapid recruitment as those of smaller species.

Each of these features, emphasizing ability to erode vegetation capital and slow population responses to that erosion, tend to provide those parameter values in plant-herbivore interactions, that lead to unstable or oscillatory outcomes for larger herbivores, particularly the nonruminants.

8.   THE BIOMASS AND TYPE OF HERBIVORES:

The distribution of herbivore biomass in relation to the physical variables, rainfall soil type and geomorphology, has been discussed by Watson (1972), Coe, Cumming and Phillipson (1976), Bell (1981a, 1982, 1984), Parker (1984) and Owen-Smith (in press). The earlier authors emphasized a simple positive regression between herbivore biomass and rainfall; however, Bell and Parker have argued that while herbivore biomass tends to increases with rainfall up to about 700 mm p.a., it tends to level off or decline at higher rainfalls. In addition, at any one rainfall, herbivore biomass is related to geomorphology and soil type, basic geology and fertile soils supporting considerably higher biomasses than acidic geology and infertile soils. The difference is especially marked at higher rainfalls. The same patterns apply to livestock and human densities (Bell 1982, Parker 1984).

The partitioning of herbivore biomass between different groups of species in different conditions has been discussed by Bell (1981, 1982 and 1984), Cumming (1982) and Owen-Smith (in press). To summarize, Owen-Smith (in press) shows that megaherbivores make up 50-70% of the herbivore biomass in most savanna communities. If one adds buffalo to the

megaherbivores, the percentage may rise to 80% of the total herbivore biomass, as in Kasungu National Park, Malawi (Bell Museum 1983). There are, however, four types of exception to this rule, as follows:

a. Areas where some or all larger herbivores (i.e., megaherbivores plus buffalo) have been eliminated by man;

b. The East African volcanic short-grass plains;

c. The Central-Southern African basement highland sour grasslands (Nyika, Highveld); and

d. High rainfall low-nutrient woodland and forest (i.e., northern Angola, central Zaire) but not the high-nutrient volcanic forests (i.e., Aberdares, Virunga, etc.)

We may perhaps summarize the situation as follows, (see also Chapter 12):

```
HIGH          | Low quality woodland  |
              | and forest with v. low|  High quality wood-
              | biomass selective     |  land and forest with
              | feeders including     |  high biomass of mixed
              | smaller antelopes     |  range of herbivores,
SOIL          | and primates.         |  elephant, rhinos,
              |                       |  giraffe, kudu, nyala,
              |                       |  buffalo, zebra,
              |_____|  hartebeest, etc.
              |                       |
WATER         |                       |_____
              |                       |
INFILTRATION  | Low quality woodland  |
              | with low biomass      |
RATE          | tolerant herbivores,  |
              | i.e., elephant,       |
              | buffalo, zebra, etc.  |  High quality fine-
              |                       |  leaved woodland short
              |_____|  grassland with high
              |                       |  biomass of selective
              | Low quality grassland |  browsers and grazers,
              | with low biomass      |  i.e., giraffe, impala,
              | medium tolerance      |  kudu, wildebeest,
              | grazers and mixed     |  gazelle, springbok.
              | feeders eland, zebra, |
LOW           | roan, reedbuck.       |
              |_____|_____

   LOW              SOIL NUTRIENTS                    HIGH
```

As before, increasing rainfall brings the horizontal lines down and the vertical lines to the right, that is, it increases the domain of the moist-oligotrophic syndrome at the expense of that of the arid-eutrophic syndrome.

9. RESPONSES OF VEGETATION TO HERBIVORE USE:

Herbivore use may alter the biomass, species composition, structure, quality and production of the vegetation and it may do so on each of the short, medium and long time scales mentioned earlier. The interactions are very complex and relate to other factors such as predation and fire.

The key question is: does use by one herbivore population make more or less food available to itself and to other herbivore populations?

In the standard models, use by one herbivore species is taken to reduce food availability both to itself and to other species (intra- and inter-specific competition). This results in negative feedback between plants and herbivores which may or may not lead to stable equilibria, as described by the Caughley models (Caughley 1975, 1976).

However, there are situations in which herbivore use may lead to the production of more available food, either for the same or other species. Examples of short-term interactions producing more food for other species are the grazing successions described by Vesey-Fitzgerald (1960), and Bell (1971), and the stimulation of grass production by grazing described by McNaughton (1979).   Examples of medium-term interactions producing more food for other species are the removal of woodland by elephant improving conditions for grazers in Tsavo (Parker and Amin 1983), or overgrazing leading to bush encroachment, improving conditions for browsers in Natal (Goodman, personal communication). Examples of medium-term improvement of food availability for the same species are provided by those situations in which woodlands respond to elephant use by coppicing (see Bell 1981; Jachmann and Bell 1984; and Bell and McShane, this volume, Chapter 10). An example of long term (evolutionary) interactions leading to improved food availability for herbivores is provided by the evolution of the grass family as a growth form co-adapted to herbivore grazing (Jewiss 1966, Bell 1969).

Can we make any generalization about the type of effect of herbivore use on vegetation and the response of vegetation to these effects?

The key factors are:

a.   How much of the vegetation is used; and

b.   What is the effect of use on the absolute and relative production of usable, nonusable and inhibitory components, that is, on future biomass and quality of the vegetation.

Taking the first point, the proportion of vegetation used is a function of vegetation quality in relation to the biomass and tolerance range of the herbivores present. If a high proportion of the vegetation falls within the tolerance range of herbivores present, the herbivore population will build up until the percentage off-take is high. Where elephants are present, the percentage use is higher still since they damage vegetation beyond their feeding tolerance range. Vegetation quality and hence percentage off-take is high in conditions favoring metabolite to cell wall growth and not favoring production of chemical defenses. Briefly, these

are areas of high soil nutrient availability and lower soil water availability, the arid-eutrophic situation as opposed to the moist-oligotrophic situation.

Turning to the question of the vegetation response to use in terms of absolute and relative production of usable, unusable and inhibitory components, we may summarize by saying that the higher the ratio of soil nutrients to soil water availability, the more likely is the vegetation to respond to use by production of high quality components that will continue to sustain high herbivore biomasses and heavy off-take. This positive feedback cycle may lead to progressive erosion of plant capital until production fails to meet herbivore requirements and a crash occurs. This may be followed by an extinction or oscillation of components as per the Caughley (1975, 1976) models, or in very high nutrient situations, by capture of the whole community by smaller sets of plants and herbivores. This last scenario is what I believe has happened in the East African volcanic short-grass plains (cf., Bell 1982). In situations of low ratios of soil nutrients to soil water (moister, more oligotrophic), the vegetation response is not of sufficiently high quality to support high herbivore biomasses and off-take, and the community is more stable with proportionately damped oscillations. Comparison of the history of Murchison Falls National Park, Uganda, with that of Tsavo National Park, Kenya illustrates the point. The former is relatively moist and oligotrophic compared to Tsavo, and the elimination of woodland by elephant resulted in a high biomass of very tall grass on which the elephants could survive but not perform well (Laws, *et al*. 1975). The elephant population thus entered a lengthy demographic slide. In Tsavo, by contrast, the woodland was replaced by relatively short sparse grass which did not provide as adequate reserve during dry spells, resulting in a sudden population crash of the elephant population (Corfield 1973). The point is that the tall grass in Murchison Falls Park acted as a damper in the system.

The situation discussed by Bell (1981), Jachmann and Bell (1984) and Bell and McShane (this volume, Chapter 10) in which elephant damage leads to woodland coppicing is an example of a probably stable equilibrium between elephants and trees at relatively high biomasses of both. Again this response seems to be characteristic of the moist-oligotrophic situation, although exceptions (i.e., Chizarira, Zimbabwe, Martin pers. comm.) do exist.

We may conclude by saying that community instability is most obvious in high fertility situations where vegetation quality is high, and in the middle range of soil water availability (rainfall and infiltration rate) where neither woodland or grassland are edaphically dominant, allowing flip-flops between phases of the community dominated by trees or grass and the appropriate fauna. The role of fire is more important in areas with high grass biomass, that is, the same middle nutrient/water range where grass biomass is neither suppressed by trees nor removed by grazers.

10. <u>CONCLUSION--COMMUNITY STABILITY AS A LANDSCAPE FEATURE</u>:

The conclusion of this brief review is that the outcome of plant-herbivore interactions is ultimately determined by the physical inputs,

particularly the balance between nutrient and water availability at different levels of the soil, as determined by rainfall, soil properties and slope. Community stucture and stability should therefore be regarded, not as a properties of particular species of animals or plants, but as a landscape properties, transmitted from the physical environment to herbivores and higher trophic levels via the biomass, quality and structure of the vegetation. As a simple rule of thumb, one may conclude that more fertile landscapes, particularly those with lower and more variable rainfalls, are more likely to feature unstable or oscillatory interactions. These will, in the long run, favor nutrient loss by erosion or leaching, leading to ultimate stabilization of the landscape at a less fertile, less productive and less biologically active level. The constant rejuvenation of the landscapes of the eastern African rift valley system, coupled with low and variable rainfall, form the basis of the conspicuous ecological dynamism of this area.

This conclusion has several consequences for wildlife management:

Firstly, it emphasizes the significance of landscape classification as the basis, firstly of understanding and secondly, of managing wildlife communities, as noted in the paper on that subject by Bell and McShane (Chapter 8).

Secondly, it proposes that certain landscapes are inherently less stable than others; these are likely to be the most productive and dramatic aesthetically. Such areas (Tsavo, Luangwa, Umfolozi) are always liable to be foci of attention and concern and conservationists' value systems must be adjusted to tolerate ecological events which are difficult and expensive to control.

Thirdly, it indicates that from the points of view of both consumptive and nonconsumptive uses, fertile active landscapes are likely to be of greater value. They tend to be more attractive scenically, they hold more animals and they have higher sustainable yields.

Finally, it should be noticed that human ecology follows similar patterns. Montesquieu (1748) in his "Spirit of the Laws" recognized that instability in human politics is correlated with soil fertility, both because it allows dense population buildup, and because it attracts invasion from less productive areas. Add uncertain rainfall and the arid-eutrophic situation is likely to be politically volatile. From the point of view of conservation, such situations are doubly problematical since dense populations of people and livestock compete for resources with wildlife. Clarke and Bell (in prep.) and Bell (this volume, Chapter 3) argue that conservation in fertile areas incorporates particular problems and costs for this reason, while Bell (1984) pointed out that confrontations at conservation area boundaries are most severe in productive landscapes, both in terms of crop damage and illegal hunting.

We may conclude by saying that all types of problem in wildlife management and conservation are likely to be more intense in fertile and drier landscapes compared to infertile and moisture landscapes. Such problems include changes due to geomorphological processes, unstable soil-plant-herbivore interactions, concern over landscape aesthetics and wildlife-human conflicts. Management planning should take this into account and adjust its objectives appropriately.

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CHAPTER 9

TREE RESPONSE TO ELEPHANT DAMAGE

BY

R.H.V. BELL & T.O. McSHANE

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1. INTRODUCTION:

One of the better known facts of wildlife ecology in Africa is that elephants damage woodland. The effect of elephants on woodland has been the subject of extensive studies, which have produced what may be described as the standard models of elephant-woodland interactions (i.e., Laws, Parker and Johnstone 1975; Caughley 1976; and Barnes 1983). The basic assumption of these models is that the effect of elephants on woodland is to reduce tree density and, therefore, to reduce food availability to elephants. The interaction of elephants and woodlands is therefore thought to be cyclic (Caughley 1976) or to reach equilibrium at low densities of elephants and trees (Laws, et al. 1975). These models have led to the view that, if the objective of management is to maintain woodland density and the elephant food supply, then a reduction of the elephant population through culling is a necessary management practice. The controversy over culling has not questioned the basic tenets of the standard models concerning ecosystem function, but has centered on differences of management objectives for the areas concerned.

It has recently been suggested, however, that under certain conditions, the effect of elephants on woodland is to increase their food supply by causing coppice regrowth of damaged trees, thus increasing browse density within their preferred height range (Bell 1981; Jachmann and Bell 1983). On similar grounds, Olivier (1978) has argued that a secondary forest provides a more favorable food supply to the Asian elephant than does primary forest. In such conditions, the outcome of the elephant-woodland interaction may be expected to be quite different from that of the standard models, reaching stable equilibria at relatively high densities of elephants and trees. If these conditions apply, both the options for management goals and the methods of reaching them are likely to differ substantially from those predicted by the standard elephant-woodland interaction models.

2. FORMULATION OF APPROACH:

In an attempt to determine which model of elephant-woodland interactions is most appropriate to each of a range of landscape units, a series of questions to be answered has been put forward and is listed below:

a. How do elephants distribute their time between different landscape units?

b. How efficiently do elephants forage in each landscape unit?

c. What is the immediate effect, in terms of uprooting, felling and breaking, of elephants feeding on the grasses, shrubs, and trees in each landscape unit?

d. What are the long-term effects, in terms of regrowth of grasses, shrubs, and trees, of elephants feeding in each landscape unit?

e.   What proportion of food intake by elephants in each landscape unit can be attributed to regrowth from plants previously used by elephants?

f.   Are the answers to the last two questions different for different vegetation types and landscape units? If so, what factors can be correlated with each response?   Possible factors include: climate, topography, soil conditions, fire, human influence, vegetation type and animal use.

The scope of this discussion centers around tree response to elephant damage, attempting to answer questions c-f above, the object being to look specifically at the response of trees to elephant damage in terms of the probability of tree death or coppicing and the rate and pattern of regrowth in each case.

The hypothesis put forward here suggests that in some areas, particularly those where soil-water dynamics generally favor plant biomass production (miombo or Guinea savannas and woodlands), the characteristic response of the vegetation is coppicing, which improves food availability to elephants for the following reasons:

a.   Tree biomass production is stimulated during regrowth;

b.   Edible biomass is brought within the height range accessible to elephants;

c.   The regrowth is of higher quality, being young and thinner (reduced secondary chemicals?);

d.   The edible biomass is denser in space, leading to larger quantities per trunkful and therefore faster intake; and

e.   The breakage pattern favors the above factors preferentially in preferred species (Jachmann and Bell 1983).

This then leads to an equilibrium between trees and elephants at relatively high biomasses of both in contrast to the standard models of cyclic or woodland removal type.

3. **PRELIMINARY INDICATIONS**:

With regard to the physical and biological conditions that lead to one or the other outcome, indications are that the following factors may be involved:

a.   **Soil Conditions**:

There is some indication that the probability of tree death is higher in relatively eutrophic, impenetrable soils than in penetrable oligotrophic soils, looking at the same tree species over a range of soil types.

b.   Climate:

Probability of tree death may be inversely related to rainfall.

c.   Fire:

The role of fire is complex. By preventing dominance of any one main stem it may stimulate coppicing, while under hot fire conditions it may prevent regrowth and raise the probability of death. The effects of fire will be landscape unit related.

d.   Tree Species:

Some tree species seem particularly intolerant of elephant damage, for example, *Acacia*, *Commiphora*, *Terminalia and Adonsonia*. Others are very tolerant, for example, the *miombo genera*, *Brachusragia*, etc., *Combretum* and, under certain conditions, *Colophospermum*.

e.   Tree Size and Shape:

The probability of tree death is nonlinear in relation to size, probability being greatest in very small and very large trees and lowest in basal diameter classes of about 3-20 cm. Also a tree that has been broken and coppiced previously has a much lower probability of death than an unbroken tree.   This means that small trees (i.e., young, stunted, coppiced) are more likely to coppice than mature stands.

f.   Stand History:

Because of the above, stand history becomes important. Areas that have been subject to cultivation, elephant attack, etc. are more resilient to the impact of elephants than protected mature stands.

4.   CONCLUDING REMARKS:

The above discussion has been presented to provide an introduction to tree response to elephant damage. It has been proposed that under the conditions outlined above, browse availability increases following damage to trees by elephants. This can be described as part of a feeding strategy that leads to an increase of browse production of preferred height-classes and of preferred species, improving the availability of food for elephants during the dry season.

In conclusion, a number of ecological factors must be considered in trying to predict the outcome of elephant-woodland interactions. The above discussion touches on one part of a considerably more complex system involving a number of components (i.e., climate, topography, soil conditions, fire, human influence, vegetation type and other animal use). All of these components must be taken into account.

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CHAPTER 10

VWAZA MARSH GAME RESERVE, MALAWI:

RESEARCH PROJECT

BY

T.O. McSHANE & E. McSHANE-CALUZI

1. INTRODUCTION:

There has now been a research project associated with Vwaza Marsh Game Reserve for two years.   The project is made up of various subprojects intended to look into and report on the research problems of immediate urgency to management.   These have been identified as:

a.   The presence of a significant elephant population with its impact on woody vegetation and crop damage.

b.   High levels of illegal activity.

c.   Proposed professional hunting safaris.

Prior to the commencement of the current research project VMGR had received relatively little research effort, amounting to a two week survey by Bell and Mphande in 1979 (Bell and Mphande 1980).

2. RESEARCH PROJECT:

The subprojects that make up the current work in the reserve are described below:

a.   Landscape Classification:

The original landscape classification for VMGR can be found in Bell and Mphande (1980).   An updated version has just recently been completed (McShane, 1984) and as more information concerning geology, landform, soils, climate, vegetation, surface water, animal occupance and past human occupance is collected, this will be further refined.   The subprojects listed below will aid in this process.

b.   Soil Survey and Analysis:

To date, soil samples from 30 sites, closely relating to the existing landscape units in VMGR, have been collected for analysis.   Samples have been collected from at least 10 cm down to ensure collection of the sub-soil; the weight of each sample being approximately 0.5 kg.   All samples have been stored in plastic bags and labelled with date collected, landscape unit, location and vegetation.   In addition, soil types have been described from 40 soil profiles dug in the reserve.

c.   Soil-Water Infiltration Measurements:

Soil-water infiltration measurements have been collected at various points within each landscape unit.   To date, a record of soil-water infiltration rates has been recorded at approximately 60 points throughout the reserve.   Infiltration rates are measured at four points within a 10 x 25 m quadrat with measurements taken over a period of one to two hours. The influence of variations in soil-moisture dynamics on the diversity and biomass of both plants and herbivores in different areas has been discussed by Coe, Cumming and Phillipson (1976) and Bell (1981 and 1982).

d. Woodland Monitoring Quadrats:

Woodland monitoring quadrats have been located on three transects running east-west through the reserve. Quadrats are located at four kilometer intervals, each being 10 x 25 m. In addition a number of quadrats have been delineated in other areas of the reserve in an attempt to improve representation of landscape units. All woody vegetation 1 m and higher has been tagged with numbered metal tags and the following data recorded: species, basal diameter, height, and damage by elephant. A close look is being taken at the relationship between elephant utilization and woodland coppice. All quadrats are monitored each year and changes from the previous year recorded.

e. Experimental Fire Plots:

Six experimental fire plots are located in selected landscape units. These include:

   (i)   Pediment alluvial

   (ii)   Alluvial levee

   (iii) Southern hills and valleys

   (iv)   Southern pediment

   (v)   Western pediment--washfans

   (vi)   Western pediment--interfluve

Each plot is made up of three subplots or treatments (50 x 50 m) which include: early burn, late burn and no burn. These have been kept simple due to difficulties in access at the end of the rains when the majority of maintenance takes place and due to labor limitations.

f. Monitoring of Illegal Activity and Law Enforcement:

Illegal activity and law enforcement is monitored on a monthly basis from analysis of patrol reports (cf., Bell 1983). A monthly index of illegal incidents per effective patrol day is determined and, based on patrol reports, patrol ground coverage is mapped. Areas of low coverage and high illegal activity are fed back to management to aid in planning patrol programs.

g. Monitoring of Animal Sighting Rates:

As with subproject (f) above, this subproject is monitored on a monthly basis from analysis of patrol reports. From this information the monthly distributions of 13 animal species are recorded on maps and a monthly index (animals seen per effective patrol day) is calculated. In addition, some preliminary strip censusing has been conducted using King's census method. Difficulties with censusing in areas of low animal densities and clumped distribution have been extensively discussed (Caughley 1977 and pers. comm.) As methods of strip censusing in VMGR

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become more refined and more easily repeatable some experimentation with different methods may lead to improved results.

h. Monitoring of Crop Damage:

In an attempt to better understand the effects of wild animals on crops along the boundary of VMGR, a preliminary assessment of crop damage along a selected section of boundary is in progress. All farms within 1 km of the reserve boundary have been mapped. The assessment comprises the following steps:

(i)   Estimate of field area by pacing.

(ii)   Estimate of crop quality in bags per acre.

(iii)   From the above, the estimate of the number of bags that would have been harvested if there had been no damage.

(iv)   Estimate of the proportion of crop damaged, identifying animals causing damage in order and extent of damage caused.

(v)   Estimate of number of bags lost to damage.

i. Elephant Dropping Survey:

Four permanently marked quadrats have been delineated in the reserve to estimate dropping accumulation over known time periods. Dropping surveys as described by Jachmann and Bell (1979 and 1983) will be carried out to aid in the determination of numbers, occupancy and age structures of the reserve's elephant population.

j. Erosion Monitoring:

Two points have been established where gullying along drainage lines has been identified as a problem. The length and width of gully increase during each rainy season is being monitored.

k. Tsetse Fly Monitoring:

VMGR contains tsetse fly (*Glossina* sp.); trypanosomiasis of cattle is endemic and cases of human sleeping sickness have been reported. Monitoring of tsetse fly distribution and densities are carried out once a month on a standard route using simple net capture. In an attempt to determine basic indices, the number of flies caught during a standard time interval with a standard size net are recorded. Blood meals are collected from a captured fly, smeared on filter paper and sent to the U.K. for host identification.

Ongoing data collection carried out in conjunction with the subprojects listed above include:

(i)   Meteorological recording and analysis.

(ii)   Vegetation inventory and collection.

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(iii)   Collection of elephant jaws for aging.

(iv)   Collection of hair samples from identifiable sources for reference slides and collection of predator droppings for analysis of content.

(v)   Collection of bone samples for carbon isotope analysis for browse/graze ratios.

3.   DISCUSSION:

For many research projects to operate, a large infusion of funds is thought to be necessary. While this may be the optimum situation, it is often not realized. However, it is possible to collect a great deal of information with limited funds and a correspondingly small but concise project. The secret lies in the ability to identify areas of priority with regard to management objectives and policy and to design a research project that will meet these needs given existing constraints. In the case of VMGR this has necessitated the concentration of many of the subprojects described above at the various quadrat sites located in the reserve. This has helped to reduce time, labor and expenditure constraints, but also has limited data collection in scope. The identification of landscape units as a first step has aided in establishing priorities so the research effort can be applied to each of the homogeneous units. As subprojects become more established or completed, the monitoring has been correspondingly expanded or reallocated.

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CHAPTER 11

CARRYING CAPACITY AND OFF-TAKE QUOTAS

BY

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1. INTRODUCTION:

The concept of carrying capacity is central to conservation and wildlife management. Where the goal is preservation for nonconsumptive uses, the difference between the carrying capacity estimate and the actual density provides an index of the success of preservation measures and of the effort required in law enforcement. The carrying capacity estimate also provides an indication of the area's potential for tourism. Where the goal is consumptive use, the carrying capacity estimate contributes to the determination of sustainable off-take quotas and the economic potential of harvesting. Where the goal is control, the carrying capacity estimate gives an indication of the effort and cost required to reduce the population to a specified level. For these reasons, it is useful to clarify precisely what is meant by the term carrying capacity, to review the methods of estimating it, and to look at what it means in terms of off-take quotas.

2. WHAT IS CARRYING CAPACITY?

The term carrying capacity has been used in a variety of different ways by different people. As a result, there has been a good deal of confusion and argument at cross-purposes. A key step in clearing up this confusion was Graeme Caughley's (1979) paper entitled: "What is this thing called carrying capacity?" Since this appeared in a very obscure symposium, it is worth summarizing the main points here.

Caughley's paper refers specifically to large herbivores. He starts by making the point that plants and herbivores exist in interactive systems and that the two components cannot be treated in isolation. Any particular plant-herbivore system will, if left undisturbed by outside off-take or input, settle down to an equilibrium state with a particular biomass of animals and a particular biomass of plants. Caughley calls this equilibrium the *"ecological carrying capacity."* This is the point at which the rate of production of edible forage equals the rate at which the edible forage is consumed by the animals. At this point, the plant biomass will be well below what it would be if there were no animals present. The animals are not necessarily in very good condition; their death rate equals their birth rate (this is why their numbers are stable), and they may be small and bear small trophies. This equilibrium is usually what a pure preservationist means by carrying capacity. However, a livestock owner, a game rancher or a park warden may well regard the situation as "overstocked" or "overpopulated."

The ecological carrying capacity is not the only possible equilibrium between plants and animals. Other equilibria can be enforced by removal of animals, and each enforced equilibrium differs from the ecological carrying capacity equilibrium in that the standing crop of animals is lower and the standing crop of edible vegetation is higher. Suppose we start at ecological carrying capacity, then set a small hunting quota which we remove each year. The animal population will drop slightly and the edible plant biomass will increase slightly. This is a new plant-herbivore equilibrium which depends on the regular off-take of that small quota. We can now increase the quota slightly and the system will shift to a third equilibrium with fewer animals and more edible forage.

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If we made a series of experiments of this kind and plotted the equilibria on a graph of standing crop of animals against standing crop of edible vegetation, the points would lie on a single curve which is called the zero isocline of vegetation. This curve defines all possible equilibria that can be enforced by sustained-yield hunting. Figure 1 shows a modelled zero isocline of vegetation and the sustained off-take needed to enforce an equilibrium at any point on the isocline.

FIGURE 1 (from Caughley 1979)
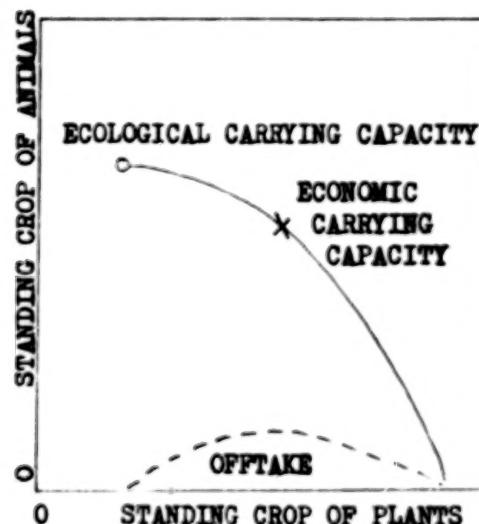
The zero isocline of vegetation marking the position of all equilibria between plants and animals enforceable by hunting. The off-take curve is the annual sustained yield necessary to enforce such equilibrium. The ecological carrying capacity point is the equilibrium in the absence of hunting whereas the economic carrying capacity point is the equilibrium enforced by a maximum sustained yield.

The next point to notice is that in Figure 1, the off-take required to stabilize the plant-herbivore system at any particular point follows a curve which rises from zero at ecological carrying capacity, reaches a maximum, then falls back to zero as the animals are removed altogether. The maximum point on this off-take curve is the maximum sustainable yield (MSY) and it occurs at a point where the number of animals is below that of ecological carrying capacity (usually between a half and three-quarters of

that level), and where the edible plant biomass is above that at ecological carrying capacity. The MSY occurs at that point on the curve at which the rate of increase of the animal population is highest, the rate of increase being determined by the number of animals multiplied by the excess of the birth over the death rate. This is the point called by Dasmann (1964), the "optimal density," and it corresponds to the point of inflection of the logistic population growth curve at which the rate of population growth per unit time begins to decrease (Mentis 1977). At the MSY point, the animals will be in good condition and have high reproductive and survival rates. Caughley calls this equilibrium point the *economic carrying capacity.* It is a situation resembling this that most livestock owners and game ranchers mean when they talk about carrying capacity.

Neither the ecological nor the economic carrying capacity or any other equilibrium point is in any sense objectively better than any other. Which is preferred depends on the objective for the area. If the objective is preservation for aesthetic or scientific reasons, ecological carrying capacity may be preferred. However, if the objective is either to obtain a sustained yield, to maintain animals in better condition with larger trophies, or to maintain a higher biomass of vegetation, the manager must apply an off-take pressure heavy enough to supply an appropriate yield or to establish the desired plant-herbivore equilibrium. The manager may not like all the linked consequences of the off-take, such as the reduction in animal numbers or the increase in vegetation, but he will have to put up with them. In short, the zero isocline represents the class of technically sound options, but the choice of which point on the isocline is enforced depends upon the value system of the manager. It is what Bell (1983) calls an aesthetic, as opposed to a technical decision.

3. **COMPLICATIONS:**

Caughley's (1979) paper gives a clear and straightforward exposition of the concept of carrying capacity. However, as he himself has pointed out often enough, life is not always as simple as that. We now have to consider a series of complications:

a. **Eruptions:**

Firstly, as Caughley (1979) points out, animal populations can exceed ecological carrying capacity whenever they are suddenly released from a constraint such as hunting, water shortage or competition from other species that has been holding them below ecological carrying capacity. Here, the classical eruption, crash, extinction or recovery to equilibrium occurs, the sequence commonly seen following the introduction of a species to a new area (i.e., moose on Isle Royale, thar in New Zealand), or the setting up of a national park (elk in Yellowstone, nyala in Lengwe, impala in Natal). This sequence was originally described by Riney (1964).

The eruption-crash sequence is caused by the fact that the animal population is confronted by a superabundant food supply in response to which it increases rapidly and overshoots ecological carrying capacity. As Caughley (1979) puts it, the reason for the overshoot lies in the herbivores' inability to distinguish between what, in monetary terms, we describe as principal (capital) and interest. To them, all edible plant

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material is food and they have no inhibition against browsing or grazing in excess of the vegetation's rate of renewal. Hence, they can reduce the supply of food available to the next generation. This introduces a lag between cause and effect which sets up an oscillation, the spectacular peak and crash of the ungulate eruption. With medium sized ungulates, this usually takes 20-30 years to complete (Caughley 1981).

An equilibrium is finally achieved, however, because the plants and herbivores are pulling in opposite directions. As the plant biomass declines, the rate of plant growth per unit biomass increases, while the food intake per animal declines, reducing animal condition and natality and increasing mortality. Except in special circumstances (see below), equilibrium at ecological carrying capacity is the inevitable outcome of this negative feedback within the plant-herbivore system.

The route to the equilibrium can be smoothed out, that is, the overshoot and crash can be reduced or eliminated by reducing the rate of increase of the animal population during the eruption. This can be done by culling at a rate adjusted to allow a slow rate of increase. This allows time for the vegetation to adjust to the herbivore increase and a gentle approach to ecological carrying capacity at which point the cull will be zero (Caughley 1977, Bell 1981a). Whether the final equilibrium is the same, whether or not the overshoot and crash is eliminated by culling, seems open to question. Riney (1964) implies that following the overshoot and crash, the habitat is degraded and the carrying capacity reduced. Caughley (1977), however, suggests that the ultimate equilibrium would be the same whether or not an overshoot and crash had taken place. This is a hard pair of alternatives to test and I am not aware of any convincing evidence on either side. My guess is that the outcome would depend on whether the crash was accompanied by a significant loss of soil nutrients, in which case the following equilibrium would have more plants and fewer animals than the former (see Bell 1982, 1983 and Chapter 9). Certainly, however, most conservationists will end up with calmer nerves if the overshoot and crash is moderated by culling.

b.   Oscillations:

In certain special circumstances, a stable equilibrium at ecological carrying capacity may never occur. These are the circumstances of heavy plant use and slow mutual responses between plants and herbivores that lead to prolonged oscillations or stable limit cycles. The conditions are outlined in Chapter 9 and analyzed in detail by Caughley (1976a and 1977). There is some evidence that in certain situations, elephants and woodlands may exist in this type of relationship (Caughley 1976b and see Chapter 10). The long-term oscillations involving predators, small mammals and vegetation in the subarctic zone are probably also of this type although here the story may be complicated by cycles in secondary chemical defenses in the vegetation (Krebs 1978).

In these circumstances, we are faced with another problem of terminology in terms of carrying capacity. How do we describe the carrying capacity of an oscillating system where the densities of animals may vary by one or two orders of magnitude? This is really a semantic argument. Some people prefer to say that the carrying capacity is continuously

changing, others to take a mean value, and yet others to take the peak value. My own view is that the concept of carrying capacity is, at best, an idealization of the outcomes of certain types of model which, in the stable limit cycle situation, is inappropriate. However, in such systems hunting or culling may have a stabilizing influence so that an equilibrium is achieved; here a stable economic carrying capacity may be intermediate between the extremes of the oscillating animal density. This is the basis for the argument that culling may be necessary to maintain relatively high elephant densities.

c.   Environmental Fluctuations:

A common situation is that densities of plants and herbivores vary continuously both within and between years in response to environmental fluctuations, particularly rainfall. In areas of high rainfall variation, usually arid areas, densities may vary greatly. Here again, it is probably strictly correct to think of ecological and economic carrying capacities varying continuously. However, in most situations, it is more practical to think of each as a series of bands of different probability. This is the approach adopted by Caughley and Walker (1983).

d.   Emigration and Immigration:

Norman Owen-Smith (in press) has concluded from simulation trials that the point on the plant-animal density curve at which a system stabilizes can be influenced by animal movement into and out of an area. He suggests that if animals are prevented from dispersing, the system comes to rest at a higher density of animals and lower density of plants than if they are allowed to disperse. One may infer that if animals are forced to immigrate into an area, the system may reach still higher animal densities and lower plant densities. This is the situation envisaged as resulting from compression of elephant populations (Laws, *et al.* 1975). Such limits to dispersal and compression may erode vegetation capital and lead to a crash or oscillation. For example, Huffaker (1958) in a classic series of experiments with orange mites, showed that both the stability and the equilibrium levels of a plant-herbivore system can be modified by manipulating the ability of the animals to move between cells of a mosaic. It is necessary to add, however, that not everyone accepts the existence of the "fence effect," that is, that preventing emigration produces a higher equilibrium density of animals. Caughley and Krebs (1983) quote data from Bayliss (1980) that purport to show that fenced and unfenced populations of kangaroos stabilize at similar densities, and argue that the fence effect is only significant for species which regulate their densities by (forced) emigration; among mammals, that is, the small ones.

e.   Predation:

In the same simulation trials, Owen-Smith (in press) showed that the equilibrium position is affected by predation. This is scarcely surprising since off-take by predators (or disease) is equivalent to off-take by man. Therefore, when discussing ecological carrying capacity it is necessary to define the level of predation assumed by the term. Equally, when discussing economic carrying capacity it is necessary to know at what point on the zero isocline the system is being held by predation in order to

estimate the balance of off-take available before the MSY point is reached. As with human off-take, the predator-prey interaction is stable if the off-take by predators is less than the MSY. If it exceeds this value, the prey population will crash leading to extinction of prey and/or predator or to oscillations. It is worth noting explicitly that predator-prey interactions are essentially identical to plant-herbivore interactions, that is, that all intertrophic level interactions are equivalent. The equivalence is due to the fact that exploitation by a higher trophic level leads to a decline in density and an increase in unit productivity of the lower trophic level. This point has been emphasized by Bell (1971) and Caughley (1976a) who used the Lotka-Volterra predator-prey models as the basis for his analysis of plant-herbivore interactions.

f.   Interactions with Other Herbivores:

Interactions between herbivore species in African ecosystems are complex, asymmetric and nonlinear (cf., Bell 1969, 1970; Bell 1982 and Chapter 9). Species may depress each other's densities by competition, increase each other's densities by facilitation or have either effect in different vegetation types, different density ranges and different time scales. Some species seem to be completely independent of each other in this respect. The details of such interactions are largely unknown and/or disputed (see Sinclair and Norton-Griffiths 1982). However, few would dispute that in order to estimate the carrying capacity of an area for one species, information on the densities of other species is required. A clear cut example is David Hopcraft's game ranch on the Athi Plains, Kenya. In the medium grass paddocks, the carrying capacity for Thomson's gazelle, a small mixed feeder of short grass plains, is very low unless grass structure is modified by livestock grazing or mowing, in which case the carrying capacity is relatively high (Hopcraft, pers. comm.) Situations of this kind imply the existence of more than one stable point (ecological carrying capacity) along the plant-herbivore isocline of the sort modelled by Walker, Ludwig, Holling and Peterman (1981). One must also recognize that, when discussing the carrying capacity of an area for a herbivore community of several species, the biomass contribution of different species may not be convertible. For example, if the total carrying capacity is estimated at say, 4,000 kg/km^2, half of this may be due to elephant; if this species is not available for some reason, it is unlikely that this component of the biomass can be replaced by some other species. It is complications of this kind that Ian Parker refers to in Chapter 18.

g.   "Genetic Carrying Capacity":

The above summary of complications due to interactions between species leads on to yet another branch of the concept of carrying capacity. This has been termed "genetic carrying capacity" by Ian MacDonald (while speaking extempore at a CSIR symposium in Pretoria in 1982) and its use was implied by Brooks and MacDonald (1983). This term means the density of each species that can exist in an area that will not cause depletion of other species to levels at which they are genetically inviable, as defined, for example, by Frankel and Soule (1981). Although not usually stated so explicitly, this idea probably corresponds to what many conservationists feel when they talk about carrying capacity. The actual equilibrium point implied can be anywhere along the zero isocline, for example, the genetic

carrying capacity for cats in canary cages is zero, and the decision as to what is accepted as such depends on the details of the ecological situation and a set of aesthetic decisions as to conservation priority (Bell 1983).

h. Economic Considerations:

The MSY point, or what Caughley (1979) calls economic carrying capacity, is not necessarily the most economic point at which to maintain a plant-herbivore system in terms of financial return. This point has been made by Mentis and Duke (1976), Clarke (1976), Mentis (1977) and Larkin (1977) among others. Firstly, as Clarke (1976) pointed out in purely financial terms, the most profitable strategy may be capital reduction of wildlife populations rather than a sustainable harvest, since the economic return on the financial capital derived from the animal capital is higher than the income from a sustainable harvest. In these circumstances (which are the rule rather than the exception), overhunting or overstocking is the correct *economic* strategy. Secondly, even assuming that the strategy of sustainable yield has been adopted for other reasons, the MSY point may not be the most financially rewarding state of the system. There are many socio-economic factors involved here, such as the costs of infrastructure (i.e., fencing, abattoires, etc.) and the influence of supply on prices. The most profitable strategy must be worked out in detail for each situation. Mentis (1977) suggests a means of making such calculations for African game ranches. Such approaches have led to the concept of "*optimum sustainable yield*" and "*optimum carrying capacity*" (Larkin 1977), which, as Bell (1980) has pointed out, is any point along the zero isocline that corresponds to the manager's value system.

4. CARRYING CAPACITY DEFINITIONS--CONCLUSIONS:

The concept of carrying capacity is weighted with emotional baggage in conservation circles because it is used to imply the RIGHT densities of animals for an area while any other density is the WRONG density. If the densities are WRONG, steps must be taken to get them RIGHT. If they are too high, the area is OVERPOPULATED and densities must be reduced by culling, while if they are too low, the area is UNDERSTOCKED and densities must be increased by reduced harvesting, law enforcement, translocation or range improvement (i.e., water sources). In either case, the angels of ecological calamity hover nearby on threatening wings.

However, we have concluded that carrying capacity may be defined in several ways which effectively allow any of the possible points of equilibrium between plants and animals to be identified as carrying capacity, from zero animals to the density that leads to a crash. We conclude, therefore, that the only embracing definition of carrying capacity is: "That density of animals and plants that allows the manager to get what he wants out of the system." Thus, any specific definition of carrying capacity must be expressed in relation to a particular objective, and it must be defined very precisely since there are no "natural" stability points in such interactive systems that act as foci for self-defining concepts. Thus, for any definition of carrying capacity for any one area, it is necessary to specify at least the following:

a. The species or group of species of which the carrying capacity is being defined;

b. The densities of those species that may be expected to interact with these;

c. The level of predation and disease (subsets of b);

d. The rates of immigration and emigration; and

e. The probable levels of variation due to external factors such as rainfall.

Owen-Smith (in press) defines as *"saturation density"* that density of a herbivore species at which a system stabilizes in the absence of human off-take and predation, with an enclosed population (i.e., with no immigration or emigration) with no competition or facilitation by other species; he also specifies the predicted amount of fluctuation in response to rainfall fluctuations. This definition is a tighter version of Caughley's "ecological carrying capacity" and refers primarily to the scientist's objective of determining the point of stability in an undisturbed population, that is to K in the logistic equation.

Caughley's "economic carrying capacity" refers to that herbivore density that corresponds to the maximum sustainable yield, usually between half and three-quarters of "ecological carrying capacity." As we have seen, the use of the term "economic" is perhaps unfortunate in that this point does not always refer to the most economically rewarding harvesting strategy. However, the sense is clear and the point itself is unique (within the specifications listed above) and its identification is not, in principle, beyond the bounds of human conjecture.

The concepts of "genetic" and "optimum" carrying capacity are more complex and subjective. They require complex biological and socio-economic analyses to establish the classes of technically sound options from which the chosen objective must be selected by aesthetic decisions. Such complex situations will not be discussed further.

5. HOW TO ESTIMATE CARRYING CAPACITY:

There are three broad approaches to estimating carrying capacities, which may be summarized as follows:

The Analytical Approach: this approach aims at constructing an estimate of carrying capacity on the basis of analytical components of the plant-herbivore system, such as the maintenance and growth requirements of different types of herbivore and the production and quality of the vegetation under various conditions.

The Comparative Approach: this approach is based on the simple assumption that areas with similar physical and biological features will have similar carrying capacities.

The Manipulative Approach: this approach is based on the idea that the response of a plant-herbivore system to manipulation (i.e., an increase or decrease in off-take) can indicate the shape of the zero isocline and where on the isocline the system is currently resting and hence, the potential carrying capacities defined in their various ways.

a.   **The Analytical Approach:**

This approach is well-illustrated by the work of Mentis (1974), Phillipson (1975), Mentis and Duke (1976), Mentis (1977), Le Houerou and Hoste (1977) and Rees (1978). Le Houerou and Hoste (1977), for example, based their estimates on ninety pairs of data points (each pair consisting of mean annual rainfall and mean annual pasture production) from eight countries in the Mediterranean basin and eight countries in the Sahelian-Sudanian zone. On the basis of these data, curves were constructed relating mean annual pasture production to mean annual rainfall in the two areas. Then, using a series of assumptions concerning the percentage of the annual production that is consumable, the energy content of the consumed forage and the energy requirements of a series of livestock types, these curves were converted into curves relating stocking rates in hectares per livestock unit to rainfall (1 Livestock Standard Unit, L.S.U., equals 1,000 pounds [= 454 kg] [Brown 1971]; 1 Tropical Livestock Unit, T.L.U., equals 250 kg [Boudet and Riviere 1968]). They finally derived equations which, for the Sahelo-Sudanian zone, was as follows:

$$y = 0.0004 x^{1.001} \qquad r = 0.89; n = 45$$

Where y is the number of tropical livestock units per hectare per year, x is the mean annual rainfall in millimeters, r is the correlation coefficient and n is the sample size. The authors made comparisons with other published data sets of the same type and noted broad agreement. However, they pointed out that the relationships determined for the Mediterranean and the Sahelo-Sudanian zone were significantly different from each other, net production being in the order of 50% higher per rainfall in the Mediterranean zone. They further noted that carrying capacities vary in relation to other factors than rainfall, and that, under given rainfall conditions, yields may vary as much as one to five times (and exceptionally one to ten times) according to soil type and range condition, while different management practices may lead to variations of equal magnitude.

A similar approach was used by Grimsdell and Bell (1975) to estimate the ecological carrying capacity of the Bangweulu floodplain, Zambia, for black lechwe.   Here, the authors estimated by clipping the protein production of the peripheral floodplain (the area in which the lechwe spend the high flood season which is thought to be the limiting period).   They

then assumed 50% consumption of protein during the high flood period and, using an estimate of protein requirement derived by scaling from livestock, calculated a possible carrying capacity for lechwe. The result was a minimum of 155 lechwe per km^2 giving a total of 185,000 for the southern floodplains.

The analytical approach has many problems associated with it, mainly related to the difficulty of converting vegetation production estimates into animal stocking rates. As emphasized in Chapter 9, there is no simple relationship between total plant production and herbivore production; the relationships are complex and nonlinear since they are strongly influenced by the relative production of the various usable, nonusable, and inhibitory plant components (that is, by vegetation quality) and by vegetation structure (see Chapter 9). Moreover, the ability of different herbivores to convert any one vegetation type into animal biomass differs radically according to digestive physiology, morphology and body size (Bell 1969, 1970, 1971 and Chapter 9; see also Mentis 1977). In my opinion, current models relating primary to secondary production in African ecosystems are far too simplified to allow the analytical approach to be used successfully in all but the simplest situations (few species and low rainfall); I believe that the approach is liable to be inaccurate and possible seriously misleading.

b.   The Comparative Approach:

In the comparative approach the area for which the carrying capacity is to be estimated is compared with other areas for which the carrying capacity is known and the carrying capacity of the most similar area is assumed to apply to the study area. This approach depends on two sets of factors:

Firstly, it depends on methods of classifying land units, by means of which the degree of similarity is assessed, that correctly identify the main factors controlling carrying capacity. Vegetation type, rainfall, soil type and the availability of surface water are the most widely used among these.

Secondly, it depends upon the reference areas actually being stocked at carrying capacity, and upon their animal biomasses being correctly estimated. It is always necessary to be aware that both assumptions may be false. Firstly, important species are frequently absent from faunal communities (i.e., elephant from Natal until recent reintroduction or white rhino from much of its range, Owen-Smith, in press). Secondly, most areas in Africa are subject to an unmeasured amount of illegal off-take in addition to any measured legal off-take, so that most conservation area populations do not fulfill the conditions for ecological carrying capacity, still less for Owen-Smith's conditions for saturation density. And thirdly, estimates of wildlife densities and biomass are notoriously inaccurate and unreliable.

East (1984) concludes that, since animal biomass are intelligibly related to certain environmental variables (i.e., rainfall, soils), therefore, the populations compared are at or near carrying capacity. I suggest, however, that the real implication of this result is that

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estimates of densities systematically depart from real carrying capacities in relation to rainfall, soils and vegetation. Thus, East African grasslands with good visibility of high densities of smaller herbivores probably produce density estimates close to actual carrying capacities because

(i)   sustainable yields are high from high densities of small animals which have high rates of increase and are, therefore, less likely to be depressed by legal and illegal off-take;

(ii)   hunting conditions in short grass plains are difficult for both predators and humans; and

(iii) estimation of population sizes is more accurate in conditions of good visibility.

In the basement woodlands, the opposite is true on all these counts so that density estimates are likely to be well below carrying capacities. Thus, while real carrying capacities are controlled by rainfall and landscape, observed values tend to exaggerate the contrasts in systematic ways, both through modification of densities by off-take and through counting bias.

Probably the best known example of the comparative approach in Africa is that based on the paper of Coe, Cumming and Phillipson (1976) relating herbivore biomasses to rainfall. These authors derived the following equation to predict herbivore biomass from mean annual rainfall:

$$y = 1.552 \ (\pm \ 0.329) \ x - 0.62 \ (\pm \ 0.903)$$

where y = log herbivore biomass (kg/km^2)
      x = log mean annual rainfall (mm)

This equation was derived using data from 24 wildlife areas in eastern and southeastern Africa, and it has been widely used to predict biomasses around Africa. However, Bell (1982) has emphasized that the data points from which the equation of Coe, *et al.* (1976) is derived are biased towards the high end of the biomass spectrum; this, Bell argued, is because the density of biologists is correlated with the density of wildlife, so that low biomass areas are underrepresented in the data set. Furthermore, Coe, *et al.* (1976) themselves note that their regression probably does not apply to areas with annual rainfall above about 800 mm which were, however, rare in their data set.

Bell (1982) assembled a larger data set which included a wider range of geomorphological situations, soil types and vegetation types. He concluded that herbivore biomass is described by a family of curves relating biomass to rainfall, each curve being characteristic of a particular geomorphological situation. The higher biomasses, occurring in high nutrient status situations such as alluvial areas, correspond with the curve described by the equation of Coe, *et al.* (1976). This curve approximately defines the upper surface of probable biomasses below 700 mm annual rainfall, although it can be exceeded in special circumstances.

Lower nutrient status situations, particularly basement plateau areas, have much lower biomasses per rainfall. Further, there are indications that herbivore carrying capacities decline above about 800 mm of annual rainfall; this is particularly clear in basement situations (see Bell 1982), where the inflection of the curve probably occurs at lower rainfall than in high nutrient situations. The relationship between the carrying capacities for elephant and humans and geology and rainfall have been examined in more detail by Parker (1984), and are discussed in Chapter 9. The data of Coe, *et al.* (1976) and Bell (1982) are summarized in Figure 2.

FIGURE 2
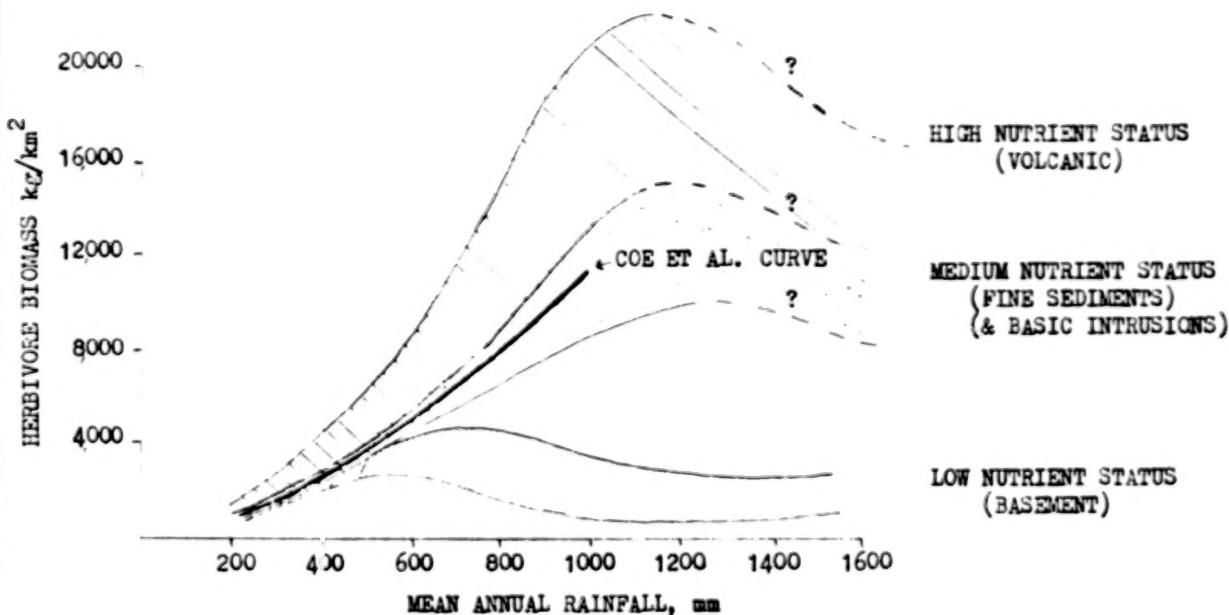
Suggested relationships between herbivore biomass, mean annual rainfall and geomorphological situation. The shaded areas are adapted from Bell (1982) and the heavy line shows the curve derived by Coe, Cumming & Phillipson (1976). Few data points fall within the white area and this may represent a genuine discontinuity in the biomass spectrum equivalent to the distinction between arid-eutrophic and moist-oligotrophic communities.

It should further be noted that the influence of rainfall on primary and secondary production is not necessarily expressed by a simple function of mean annual precipitation. This point has been made by Walter (1951) and Le Houerou and Hoste (1977) among others; these authors point out the efficacy of rainfall in stimulating production is strongly influenced by potential evapotranspiration and, hence, by temperatures, wind, cover, etc. In consequence, winter rainfall tends to be more efficient than summer rainfall (see also Condon 1968). Other authors, such as Jager (1981) and Western (unpublished) have shown that the intensity and seasonal distribution of rainfall is important. Intense rainfall tends to be less efficient due to relatively high runoff, while double rain seasons appear to produce lower production and carrying capacities than the same rain total in single rain seasons, presumably because of the interruption of growth.

The most detailed example of the comparative approach is that of Condon (1968), developed for estimating livestock carrying capacities in arid lands in Australia. Condon's method is to relate the area in question to a standard reference area by means of comparative weightings on a series of axes each of which refers to a particular environmental parameter. Condon chose as his "base value" an area "with red sandy loam brown acid soil, of level to slightly undulating topography, carrying open mulga scrub with certain grass species pastures of moderate to good palatability. Long-term stocking records show this class of country to have a grazing capacity of 8.0 dry sheep per 100 acres (one sheep per 12.5 acres) at an average annual rainfall of ten inches (254 mm)." Note that Condon's grazing capacity more closely represents "economic" than "ecological" carrying capacity, the objective being to minimize soil erosion and pasture degeneration.

The environmental parameters used to modify this base value were:

a. rainfall, with weighting factors for winter and summer rainfall, using a rainfall-grazing capacity curve similar to that derived by Le Houerou and Hoste (1977);

b. soil fertility, moisture relationships and erodibility;

c. topography, with negative weighting for slopes leading to runoff and positive weightings for situations with runon;

d. tree densities, using a series of calibrated weightings for four tree types at different tree spacings and a weighting for tree clumpiness;

e. two weighting factors based on pasture type were used and one for pasture condition; and

f. barren areas, using a weighting factor related to the proportion of barren areas, i.e., salt pans, rocky areas, etc.

Thus, the grazing capacity of an area is given by the base value (1 = 8 sheep/100 acres) multiplied by a weighting value (i.e., 1.3 for rainfall, 0.7 for soil fertility, 0.2 for dense woodland of class C tree type, etc.) for each of the above factors.

My feeling is that this system is excellent in principle but impossible to put into practice in African wildlife situations, at present, since the necessary calibration data do not currently exist (which in any case would be different for each herbivore species). It would be a useful project to collate and generate the data needed to develop a system of this kind for African wildlife ecosystems; it would, however, be a colossal undertaking with many methodological difficulties. It would also require clear and consistent decisions as to which definition of carrying capacity was being used against which to calibrate weighting factors and as to how to handle oscillatory situations.

A simple version of the comparative approach to carrying capacity estimation was used by Grimsdell and Bell (1975) in a second attempt to estimate the carrying capacity of the Bangweulu floodplain for black lechwe. Here, the Kafue floodplain, where the Kafue lechwe was clearly at carrying capacity (Rees 1978) was used as a reference for comparison. Here, the lechwe occurred at a density of 1,000 lechwe per kilometer of floodline (Bell, Grimsdell, van Lavieren and Sayer 1973). Applying this figure to the 160 km of floodline in the southern Bangweulu floodplains, an estimated carrying capacity of 160,000 black lechwe was obtained.

c. The Manipulative Approach:

I use this term to refer to any of a variety of methods that make use of system models to estimate carrying capacity since such methods normally require the system to change to some extent in response to some form of manipulation in order for the particulars of the model to express themselves.

One such method is described by Caughley (1977), page 181, on the basis of a model developed by Morisita (1965). "If a population is increasing towards an assumed steady density of unknown magnitude (i.e., towards an unknown carrying capacity), a logistic curve can be fitted to the trend of numbers with time to provide estimates of r_m and k. During logistic growth, the trend of $(N_{t+1} - N_t)/N_t$ is linear on N_{t+1} such that

$$(N_{t+1} - N_t)/N_t = a - bN_{t+1}$$

where $a = e^{r_m} - 1$ and $b = a/K$. Consequently, both r_m and K can be estimated by least-squares regression if estimates of N are available from three or more consecutive years. MSY can then also be estimated from the instantaneous rate of harvesting, $H = r_m/2$ appropriate to a population of size K/2."

Grimsdell and Bell (1975) used a modification of this method to make yet a third estimate of the carrying capacity of the Bangweulu floodplains for black lechwe. It had been concluded that the population was stable at about 17,000 animals as a result of a harvest by lion and illegal hunters of about 4,130 animals per year, this being the sustained yield, SY, and

that the intrinsic rate of natural increase, r_m, was 0.28. Now using the logistic equation shown in Caughley (1977) from Graham (1935):

$SY = r_m N(K-N)/K$ or $r_m N(1-N/K)$, where N is the population size at which the SY is required, a set of values of SY for an N of 17,000 was calculated using a series of values for K as follows:

N	K	SY
17,000	50,000	3,125
17,000	100,000	3,950
17,000	160,000	4,250
17,000	200,000	4,350
17,000	300,000	4,500

It can be seen that the K value that corresponds most closely to the estimated SY of 4,130 is 160,000, which agrees surprisingly well with the other two estimates by the analytical method (185,000) and the comparative method (160,000). However, it should be noted firstly that the method is very sensitive, that is, that a small difference in SY makes a big difference to the estimate of K, while the estimates of N and SY are likely to contain considerable errors. The best one can say of Grimsdell and Bell's example is that, on the face of it, it does not contradict the other estimates. This method might be useful if sufficient data are available to calculate the carrying capacity of an area for a population subjected to illegal off-take; it depends on a fairly good estimate of the rate of illegal off-take, for example, by the methods described in Chapter 22.

A simpler variant of this method has been suggested by Bell (unpublished letter, 1983) for situations such as national parks where the object is to specify a maximum tolerable limit to illegal off-take (see Chapter 35 on master plans), the goal being to keep the population in question close to carrying capacity, but where the carrying capacity is unknown. Here, it is sufficient to reduce the illegal off-take to a relatively low fraction of the intrinsic rate of natural increase, r_m (see below) as a multiple of the current population size; the population will then automatically increase to a level close to the carrying capacity. Monitoring of the level of illegal off-take and the population size should then allow rather good estimates of the zero isocline and the various yield parameters.

6. ESTIMATING CARRYING CAPACITIES--CONCLUSIONS:

The estimation of carrying capacities is the graveyard of ecological reputations. It is easy to be wrong; it is easy to be shown to be wrong; and being wrong can be expensive.

Estimating carrying capacity is one of the most difficult tasks facing a wildlife biologist. Firstly, he needs a clear statement of what definition of carrying capacity is intended, and secondly, he is faced with great technical difficulties in determining what density of animals corresponds with this definition. The estimate requires the use of one of

several rather complex models of the plant-herbivore system and fairly accurate data on a number of factors that are not always easy to measure. Amateur conservationists use the term carrying capacity very freely and base a lot on it; however, it is fair to presume that they are usually unaware of the conceptual and technical difficulties involved.

In my opinion, the analytical approach to deriving carrying capacities from primary production estimates via estimates of herbivore food chain efficiency is decidedly premature in the present state of our understanding of the feeding ecology of African wildlife. I feel that the most reliable means of getting a reasonable "ballpark" estimate of carrying capacity is by means of the comparative approach as used by Coe, *et al.* (1976) and modified by Bell (1982) and Parker (1984). However, this method must be used with caution. Firstly, it depends upon a valid comparison between areas, based on an objective system of landscape classification (see Chapter 8). Ultimately, the aim should be to develop an analytical approach to landscape comparison of the sort advocated by Condon (1968). Secondly, one must recognize that many, or even most of the biomass data points used by Coe, *et al.* (1976), Bell (1982), Parker (1984) and others do not accurately represent systems at carrying capacity, either because species are missing altogether, or because of unmeasured off-take, or because of census errors; this problem is particularly severe in low carrying capacity areas which are relatively vulnerable to harvesting pressure (see below). Finally, they are subject to a variety of problems due to variations in rainfall patterns and efficiency, to intrinsic and extrinsic oscillations, to animal movements and to predation pressures.

The manipulative approach has two great advantages. Firstly, the manipulation itself contributes to the manipulator's understanding of the system, that is, it embodies the concept of adaptive management; it makes use of management to improve the quality of management. It means that the manager need not be paralyzed by lack of good information. Secondly, it provides direct information on harvesting rates, which is often the reason why carrying capacity is being estimated. The manipulative approach is, therefore, probably appropriate to progressive fine tuning of the estimate after a broad estimate had been made by the comparative approach.

7. DETERMINING OFF-TAKE QUOTAS:

We are here concerned with two types of off-take quota, firstly quotas for sustainable yields of average adult animals, usually for meat (subsistence quotas), and secondly, quotas for sustainable yields of exceptional large males, for trophies (trophy quotas):

a. Subsistence Quotas:

There is a large literature on this subject, but it has been reduced to a few simple principles by Graeme Caughley in his 1977 book "Analysis of Vertebrate Populations," Chapter 11. The main points are quoted here, but the reader is referred to that book for the full treatment.

The simplest model of population growth is the logistic model. It is oversimplified and rather unrealistic but provides a useful introduction to the subject. The logistic equation is as follows:

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$$r = r_m \cdot (1 - N/K)$$

where N = population size,

r = its rate of exponential increase,

r_m = its maximum intrinsic rate of increase, and

K = population size at steady density (i.e., carrying capacity).

Graham (1935) first applied the logistic equation to sustained yield questions. He pointed out that because rN is the instantaneous production of animals over and above the production required to hold the population stable, it also equals the sustained yield. The rate of harvesting (H) required to hold the population constant at N can now be found from the equation:

$$HN = r_m N (1 - N/K)$$

The sustainable yield, SY equals HN for any level of N, so that the maximum sustained yield, MSY can be calculated very simply:

> The MSY is obtained from a population size of N = K/2 at a harvesting rate of H = $r_m/2$ to yield HN = r_m K/4 animals each year. Put more simply, the MSY is produced when the population is reduced to half its density at carrying capacity and harvested at half its maximum intrinsic rate of increase.

Caughley (1977) goes on to show how using the logistic model in various circumstances, the values of r_m, K and SY can be calculated, some of these methods have been touched on in Section 5 of this Chapter. However, he continues by pointing out that the logistic model is considerably less realistic than interactive models of plant-herbivore interactions with or without consideration of a predator trophic level. Such models are more complex than the logistic model and, as Caughley says, at this stage of the game it is too much to hope that the data needed to use them in practice might be available. He notes, however, that there are approximate methods of calculating MSY by the interactive model which circumvent the need to estimate the full range of parameters. Although approximations, they are liable to return estimate more accurate than logistic estimates. These calculations are shown in Caughley (1976), but briefly, they lead to estimates of MSY generally somewhat lower than the equivalent logistic estimates. Further, the MSY is produced by a larger population (0.7 x carrying capacity instead of 0.5 x carrying capacity) than that estimated by logistic models. The disparity between the two sets of estimates of MSY serves as yet another warning against an uncritical approach to the estimation of carrying capacities and sustainable yields.

b. Estimation of r_m:

The next requirement in calculating sustainable yields from the above models is an estimate of r_m, the maximum intrinsic rate of increase of a population. There is now a considerable and growing literature giving empirically determined values for a wide range of African wildlife species. Some of the data is reviewed by Western (1979) and Caughley and Krebs (1983). These authors derive the following equations relating life history parameters to mean body size:

(i) Birth rate (b_r) as a % of the population per year:

(1) For artyodactyls (Western 1979):

$$\log b_r = 3.18 - 0.35 \log W \quad \text{(W in grams)};$$

$$b_r = 1,513W^{-0.35}$$

(2) For all ungulates, carnivores and small mammals, Western (1979):

$$\log b_r = 3.09 - 0.33 \log W \quad \text{(W in grams)};$$

$$b_r = 1,230W^{-0.33}$$

(ii) r_m as a fraction of population size:

(1) For a range of species (Caughley and Krebs 1983):

$$r_m = 1.5W^{-0.36} \quad \text{(W in kg)};$$

(2) For a range of homeotherms (Fenchel 1974, quoted by Western 1979):

$$r_m = 1.4W^{-0.28} \quad \text{(W in kg)}.$$

These equations give the following values expressed as % of population size for three species of mean weights of 10, 100, and 1,000 kg respectively:

	MEAN WEIGHT (kg)		
	10	100	1000
br (Eq ia) :	60.2 %	26.9 %	12.0 %
br (Eq ib) :	58.9 %	27.5 %	12.9 %
r_m (Eq iia) :	65.5 %	28.6 %	12.5 %
r_m (Eq iib) :	73.5 %	38.5 %	20.2 %

These figures show a fair correspondence between the first three equations, while the last equation (Eq iib of Fenchel 1974) seems to give values of r_m which are too high for most large African herbivores. It is interesting that Eq iia of Caughley and Krebs (1983) for r_m gives slightly

higher values than Western's (1979) equations (Eq ia and Eq ib) for birth rate, although the difference is very small and probably insignificant. This implies that r_m is achieved when mortality is very low or absent.

Since the two curves are so similar, it is immaterial which is used; however, the birth rate has the conceptual advantage that it does not include an unknown quantity of "natural" mortality, so that when calculating the proportion of the population increment available for harvesting, one makes out a total estimate of mortality, including "natural," predation, illegal hunting, control hunting, etc. Any surplus between the sum of these forms of mortality and the birth rate is available for harvesting (Bell and Mphande 1980), or for population increase (see Chapter 22 and 26).

A final point worth noticing is that the values of b_r or r_m derived from these equations (leaving aside Eq iib) are all somewhat higher than the r_m values modelled for a range of African ungulates. For example, Grimsdell and Bell (1975) derived an r_m value for black lechwe (mean weight 63 kg) of 0.28, using a young age distribution and a sex ratio biased slightly in favor of females. However, equations ia, ib and ic give values of 0.32, 0.32 and 0.34 respectively, for this mean weight. For elephant, using the mean population weight of 1,725 kg from Coe, *et al.* (1976), the equations give r_m values of 0.099, 0.107 and 0.102 respectively. Hanks and McIntosh (1973) argued from a computer simulation that under optimum conditions an elephant population cannot increase at a rate higher than 4% per year. However, Hall-Martin (pers. comm.) has collated data to show that the confined elephant population in Addo National Park increased at a mean rate of 7% per year over a 25-year period, while Van Wyk and Fairall (1966) quoted by Barnes (1979) show that the elephant population of Kruger National Park grew at a constant rate of 9% p.a. over a 70-year period (although counting bias and immigration may contribute to this). My guess is that the birth rate of 9% p.a. for elephant quoted by Western (1979) from Laws (1966) gives a reasonable estimate of r_m for this species. My impression, then, is that computer simulations of r_m tend to err on the low side since they usually include significant mortality, whereas in an erupting population well below carrying capacity, mortality may be very low indeed. This underestimation of r_m may be exaggerated with elephant as recent revisions of Laws' (1966) aging criteria (Jachmann, in press; Craig, unpublished) indicate that elephants may conceive at significantly younger ages than has previously been assumed.

c.   Estimation of Trophy Quotas:

As Rowan Martin points out in Chapter 17, sport hunting has quite different characteristics from other forms of off-take in that the harvest is usually confined to a relatively minute segment of the population so that the impact on the population is very small. Various complex models have been developed for some species to predict the productivity of trophy class animals under different conditions. These, however, are impractical in most African conditions, so I will here simply quote figures derived empirically for the setting of sport hunting quotas by the Department of National Parks and Wildlife Management, Zimbabwe (Cumming, pers. comm.):

Suggested Trophy Quotas as % of Total Population Per Year

Elephant	0.5%
White rhino	1.0%
Black rhino	1.0%
Hippo	1.0%
Lion	10 %
Leopard	10 %
Ungulates of mean adult weight 100 - 1,000 kg	2%
Ungulates of mean adult weight less than 100 kg	2%

In many cases, it is desirable to initiate hunting in areas where population sizes are unknown. In these situations it is meaningless to attempt to set quotas on a percentage basis, and it may be preferable to set quotas by specifying minimum sizes of individuals that may be taken. For example, any elephant might be allowed with a combined tusk weight in excess of 30 kg, or any *Pterocarpus angolensis* tree might be cut with a basal diameter greater than, say, 50 cm. The quota is then regulated by the rate of recruitment of individuals to the permitted size classes. This quota system has been advocated by Bell (1984) and it is suitable for species where the feature, which is the basis of selection, increases continuously with age, so that only the older individuals are removed, leaving a protected segment of breeding adults. This is not true of most African antelope, which tend to achieve maximum horn length in early maturity then lose length from wear (Grimsdell and Bell 1975; Berry 1984). (There are exceptions, notably among the Tragelaphines, Bell, unpublished data). The system has been further criticized on the grounds that it will lead to selection for smaller trophies, but I am not convinced that, in this respect, it differs from any other form of trophy hunting. Further pros and cons are discussed by Bell (1984).

8. OFF-TAKE QUOTAS--CONCLUSIONS:

The setting of off-take quotas is an obvious candidate for adaptive management. We have "ballpark" methods of estimating the two required parameters, K and r_m and a variety of models for estimating the MSY from these. Provided we do not consistently exceed the MSY, we are unlikely to do the ecosystem any irreparable harm. If we use Western's (1979) equation for artyodactyl birth rates ($b_r = 1,513 \ W^{-0.35}$; weight in grams) to estimate r_m and Graham's (1935) logistic equation (MSY = $0.5 \ r_m \times 0.5 \ K$), to estimate MSY, we are probably fairly safe to begin with.

Once initiated, the off-take program itself provides the best means of refining both the system model and the estimates of its various parameters. Usually, the only really reliable statistics available are the legal off-take and the condition data derived from harvested animals. As Caughley (1977) pointed out, the off-take can be used to estimate numbers by relating to an index of population size. This method was used by Bell (unpublished data) to obtain an estimate of warthog numbers in Lengwe National Park, Malawi. Here, an annual count of sightings at water holes had been made for 17 years showing a smooth increase of sightings of 35% p.a. (Bell 1981). In 1983, the sighting rate was 783 warthog per day, so that given a 35% increase, the sighting rate in 1984 should have been 783 x 1.35 = 1,057. However, during 1984, a total of 154 warthog were shot in a

culling program. Following this, the 1984 water hole sighting rate was 301 warthog per day, that is, 28.5% of the expected number. This means that removal of 154 warthog reduced the sighting rate by 759 sightings per day, so that each warthog removed was worth 759/154 = 4.9 sightings per day. This implies that warthog in those (very hot) conditions visit water holes 4.9 times per day each, a figure that agrees well with Cumming's (1975) conclusion that warthog drink four times per day in very hot weather. This, in turn, implies that the warthog population was 200 in 1983, increased to about 216 by mid-1984, and was then reduced by a cull of 154 animals to a total of about 61 by late 1984. In this case the population size, and hence, the off-take quota, had been seriously overestimated (Bell 1981, notwithstanding), but the cull itself provided a means of correcting this error.

The same emphasis on monitoring and feedback from off-take, for example, by catch-per-effort records, applies to sport hunting.

9.   **MULTI-SPECIES SITUATIONS**:

The emphasis in this paper so far has been on relatively simple single species situations.   However, most African wildlife situations are considerably more complex, with a wide range of herbivore species actually or potentially involved. Key questions in planning the use and management of an area, are:

What is the total carrying capacity of the area?

How will the biomass be partitioned between species? and

To what extent are the contributions to the biomass by different species interchangeable?

We have already covered the question of total carrying capacity. In discussing the second question of partitioning of biomass between species, a range of perceived "optimal mixes" can be expected, corresponding to the different perceptions of the concept of carrying capacity. We will here only consider the "ecological species mix" corresponding to the equilibrium "saturation densities" as defined by Owen-Smith (in press) of a full faunal community as reconstructed from records of recent historical occurrence in the area concerned, existing in an enclosed hands-off situation. As with carrying capacity, the same three approaches are theoretically available, but here we will use only the comparative approach.

No two faunal communities are identical in species composition or relative densities; communities vary continuously, presenting conceptual difficulties in community classification as discussed by Clarke and Bell (in prep.) The best known classification of the zoogeographical zones of African ungulates is that of Ansell (1971), while the factors influencing faunal community structure have been discussed by Lamprey (1963, 1964), Bell (1969, 1971, 1981a and b, 1982 and Chapter 9), Mentis (1974), Cumming (1982), Huntley (1982) and Owen-Smith (in press) among others.

Briefly, we can identify nine main types of African ungulate community as follows:

1 : Desert and semi-desert communities   a : Sudano-Sahelian
      Desert and semi-desert communities   b : Karoo, Kalahari,
                                                  Namibian

2 : Arid-eutrophic savanna communities   a : with woodland
      Arid-eutrophic savanna communities   b : grassland

3 : Moist-oligotrophic savanna communities a : with woodland
      Moist-oligotrophic savanna communities b : grassland

4 : Forest communities   a : Eutrophic
      Forest communities   b : Oligotrophic

5 : Floodplain communities

In classifying large herbivores into ecological groups, it is useful to distinguish between grazers, browsers and mixed feeders and between animals with mean body weights in the ranges:

Large   :   over 1,000 kg = Megaherbivores of Owen-Smith (in press);

Medium   :   100 - 1,000 kg; and

Small   :   under 100 kg.

This gives a matrix of nine ecological groups; it is also useful to distinguish a tenth group, containing only zebra and buffalo, from the group of medium grazers, in order to separate this subgroup of relatively unselective coarse feeders from the remainder of this group which are relatively selective for vegetation structure and quality. I personally do not find the category "bulk and roughage feeder" of Hofmann (1973) a very useful category since it confuses species which are tolerant both of structure and quality (i.e., elephant and buffalo), with those that are tolerant of quality only (i.e., wildebeest) and not particularly tolerant even of that. The ecological groups of herbivores are summarized in Table 1.

TABLE 1

ECOLOGICAL GROUPS OF LARGE AFRICAN HERBIVORES

FEEDING TYPE / MEAN ADULT WEIGHT	GRAZERS		MIXED FEEDERS		BROWSERS	
LARGE, i.e., over 1000 kg	White Rhino Hippopotamus		Elephant		Black Rhino Giraffe	
MEDIUM, i.e., 100-1000 kg	Oryx Roan Sable Waterbuck Hartebeest Topi	Buffalo Zebra Wildebeest Cattle	Eland Addax Scimitar Oryx		Greater Kudu Bongo Okapi Camel	
SMALL, i.e., less than 100 kg	Warthog Forest Hog Lechwe Reedbuck Kob Puku	Blesbok Oribi Sitatunga Sheep	Bushpig Nyala Impala Grant Gazelle Thomson Gazelle Springbok	Ostrich Goat	Lesser Kudu Bushbuck Gerenuk Duikers Suni Grysbuck	Steinbuck Klipspringer

I do not have access to good data sets from all nine community types to show how the herbivore biomass in each is distributed between groups. The following is therefore open to correction when better data become available, bearing in mind also the caveats against assuming that biomass data represent accurate estimates of complete communities at carrying capacity:

1a: Desert and semi-desert community; Kalahari, from Graham (unpublished):

% OF TOTAL BIOMASS IN EACH HERBIVORE GROUP

	GRAZERS	MIXED	BROWSERS	TOTAL
Large	0	0	5	5
Medium	10 / 50	20	5	85
Small	0	10	0	10
Total	60	30	10	100

2a: Arid-eutrophic savanna community; with woodland; Luangwa Valley, Zambia, data combined from Caughley (1973) and Douglas-Hamilton, *et al.* (1979):

% OF TOTAL BIOMASS IN EACH HERBIVORE GROUP

	GRAZERS	MIXED	BROWSERS	TOTAL
Large	10	73	1	84
Medium	12 / 1.5	0.5	0.2	14.2
Small	0.5	1	0.3	1.8
Total	24	74.5	1.5	100

2b: Arid-eutrophic savanna community, grassland, Western Serengeti, Tanzania, from Bell (1969):

% OF TOTAL BIOMASS IN EACH HERBIVORE GROUP

	GRAZERS	MIXED	BROWSERS	TOTAL
Large	0	0	5	5
Medium	63.5 18	6.5	0	88
Small	2	4	1	7
Total	83.5	10.5	6	100

These data refer to the Western Serengeti as a whole.   As was emphasized by Bell (1969), this area contains a series of subcommunities related to land form that differ considerably in the ratios of grazers, the shorter grass areas in northwest being dominated by wildebeest and gazelles, the taller grass areas in the southeast being dominated by buffalo, zebra and topi.   The populations increased considerably in subsequent years (see Sinclair and Norton-Griffiths 1979), but species ratios remained approximately similar.   The Serengeti migratory populations resemble more closely those of the northwestern corridor, being dominated in biomass by wildebeest, zebra and gazelle.   The comparative scarcity of elephant in the Serengeti may be at least partially an artifact of the human history of the area, although in the pure grassland areas, they cannot survive.

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3a: Moist-oligotrophic savanna, with woodland; Kasungu National Park,
     Malawi, from Bell (1983):

% OF TOTAL BIOMASS IN EACH HERBIVORE GROUP

	GRAZERS	MIXED	BROWSERS	TOTAL
Large	1	55	0.5	56.5
Medium	22 / 11	3.5	1.5	38
Small	1.5	0.5	3.5	5.5
Total	35.5	59	5.5	100

The percentage of biomass contributed by elephant and buffalo could
probably rise considerably higher since both species are currently below
carrying capacity as a result of past settlement and current illegal
hunting.   However, in the moister and more oligotrophic parts of this
community, bordering on the oligotrophic forest in, say, northern Zambia,
northern Angola and southern Zaire, the contribution of elephant to this
community falls conspicuously and the overall biomass is correspondingly
reduced, see for example, Huntley (1982).

3b: Moist-oligotrophic savanna, grassland; Nyika plateau, Malawi, from Bell (unpublished data):

% OF TOTAL BIOMASS IN EACH HERBIVORE GROUP

	GRAZERS	MIXED	BROWSERS	TOTAL
Large	0	0	0	0
Medium	16 29	24	0	69
Small	28	1.5	1.5	31
Total	73	25.5	1.5	100

4a: Forest communities, eutrophic; no reliable data exist; the following is based on an unpublished aerial survey of the treetops salient, Aberdares National Park, Kenya, by Watson, Graham, Woodley and Bell in 1966.

% OF TOTAL BIOMASS IN EACH HERBIVORE GROUP

	GRAZERS	MIXED	BROWSERS	TOTAL
Large	0	40	5	45
Medium	2 37	1	5	45
Small	5	0	5	10
Total	44	41	15	100

4b: Forest communities, oligotrophic; no reliable data exist, but the following is based on information supplied from Sapo National Park, Liberia, by N. Bell and N. Penn (unpublished):

% OF TOTAL BIOMASS IN EACH HERBIVORE GROUP

	GRAZERS	MIXED	BROWSERS	TOTAL
Large	0	5	0	5
Medium	0 [10]	0	0	10
Small	5	20	60	85
Total	5	25	60	100

It is not clear whether the relatively low densities of forest elephant and buffalo represent carrying capacity densities or whether these species are reduced by hunting. Nonetheless, it seems clear that there is a real distinction between the contribution of the larger herbivores to the biomass in the oligotrophic as opposed to the eutrophic forests.

5: Floodplain communities, the Bangweulu floodplain, Zambia, from
Grimsdell and Bell (1975):

% OF TOTAL BIOMASS IN EACH HERBIVORE GROUP

	GRAZERS	MIXED	BROWSERS	TOTAL
Large	1	5	0	6
Medium	5	10	0	0	15
Small	76	1	2	79
Total	92	6	2	100

It is likely that all species in the Bangweulu floodplain were below
carrying capacity at the time of these surveys and that larger species,
particularly elephant and buffalo, had been disproportionately affected.
Bangwelu is a relatively oligotrophic floodplain; in more eutrophic
floodplains such as the Zambezi delta, Mozambique, the Elephant Marsh,
Malawi and Mana Pools, Zimbabwe, the biomass is dominated by large species,
particularly hippo, buffalo and elephant.

10.   SPECIES MIXTURES--CONCLUSIONS:

Four general points can be made about multi-species mixtures:

Firstly, the data on which to base comparisons to predict mixed
species carrying capacities are very poor: counts are unreliable and
unevenly biassed; many communities are incomplete; and most populations are
more or less influenced by human activity. These departures from the ideal
are most pronounced in oligotrophic woodlands where visibility is poor,
distributions clumped (and therefore liable to large sampling error), and
animal densities low (and therefore vulnerable to hunting pressures).
Therefore, caution is required in predicting species mixes from such data.

Secondly, herbivore community structure is extremely flexible in
response to differences of landscape type. Classification of communities
as attempted above is of marginal value at best. Perhaps the approach
towards which we should be aiming is to attempt to build up a picture of
the carrying capacities of individual landscape units and land facets (see
Chapter 8), so that the carrying capacity of an area can be estimated by
the relative proportions of its component facets, bearing in mind that a

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particular combination of facets may boost the carrying capacity above that of the sum of its parts, as in the Serengeti ecosystem.

Thirdly, we agree with Owen-Smith (in press) that in most savanna communities, megaherbivores usually contribute 40%-70% of the biomass, except where they have been eliminated by man or where fibre production is limited by low infiltration (Serengeti, Nyika) or by flooding (floodplains), (see Chapter 9).

Fourthly, I would expect that there is relatively little opportunity for substitution of biomass by species *between* ecological groups, although there may be some opportunity for substitution *within* groups, particularly of medium grazer biomass by livestock. If for any reason the biomass contribution of megaherbivores cannot be taken advantage of, it is doubtful if much of it can be made up for with other species.

* * *

As a postscript, a recent paper by East (1984) examines the relationship between biomass, rainfall and soil nutrients for a wide range of large African savanna mammals. From East's regressions, a range of carrying capacities for mixed communities might be built up from individual species values, on the assumption of rather limited interaction or substitution between species biomass. East concludes that the relationships between biomass, rainfall and soil nutrients proposed by Watson (1972), Coe, *et al*. (1976), and Bell (1982) for whole communities apply to the majority of individual herbivore species. In addition, he recognizes a division of savanna herbivores into two groups, which he calls "arid savanna herbivores" and "moist savanna herbivores." "Arid savanna herbivores," which dominate total herbivore biomass, include grazers, mixed feeders and browsers and include the very tolerant species such as elephant, buffalo and hippopotamus. Their biomass tends to decline at higher levels of rainfall on low nutrient soils, and only the very tolerant members of this group (listed above) are widespread in moist-oligotrophic situations with over 1000 mm annual rainfall. "Moist savanna herbivores" are mainly highly selective grazers such as sable, roan, hartebeest, reedbuck, oribi and warthog. They occur widely in moist-oligotrophic situations; their biomasses are usually low, but are distinguished by the fact that they show a positive correlation between biomass and rainfall, even in high rainfall areas.

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CHAPTER 12

ALLOCATING HUNTING LICENSES BY LOTTERY: AN EXERCISE TO DEMONSTRATE REAL-LIFE RESEARCH REQUIREMENTS

BY

R.B. MARTIN, I.S.C. PARKER AND R.H.V. BELL

1.   INTRODUCTION:

This is a report of an exercise that was introduced to the workshop in order to provide a real-life example of what management needs to know when making a decision on wildlife utilization.   The object was to emphasize once again the fact that wildlife research must be directed towards the real requirements of decision making, and must, therefore, concentrate at least as much on political, social and economic questions as strictly ecological ones.   Wildlife management concerns the wildlife-human interaction and the human side must be understood.

The basis of the exercise is a model of annual range management decisions in a conservation area in Mexico in a paper by Anne Whyte in the special issue of the *International Social Science Journal*, Vol. XXXIV, No. 2, 1982, by Brookfield, Spooner, Whyte, De'Ath, Zube, Dube and Himmelstrand, entitled *Man in Ecosystems*, 93.

The model is shown in Figure 1.   It attempts to demonstrate in the form of a simple flow-diagram the relationships between various types of decision (of resource management by rural dwellers, biosphere reserve policy, credit bank policy and land reform policy) and various key physical and biological processes.   This model was used as an example both of the need to incorporate socio-economic factors in models of resource use, and of the flow-diagram method of displaying such models.

2.   THE HUNTING LOTTERY PROPOSAL:

The exercise was based on a system of allocating hunting licenses by lottery used in Botswana, but here it was adapted to a particular situation.   The situation and conditions were as follows:

The wildlife resources are contained in a hypothetical game reserve of 1000 km^2 area, surrounded by dense settlement.   The game reserve has been created within the last ten years, its creation involving the removal of 2000-4000 people.   This has caused considerable resentment and there has been pressure to excise parts of the reserve to reopen them to settlement. Landscape units suitable for settlement cover a small proportion of the reserve (say 20%), but are also key areas for wildlife and wildlife uses, such as safari hunting and tourism.   The area has a medium wildlife carrying capacity, estimated at about 4000 Kg/km^2, giving an estimated carrying capacity of 1200 elephant, 1800 buffalo, 200 hippo and reasonable numbers of antelope and zebra.   Lion and leopard are also present.

Currently the wildlife densities are well below carrying capacity both because of recent removal of settlement and because of heavy illegal off-take concentrating on elephants and buffalo.   Current numbers are estimated as elephants 300 and buffalo 600.   Buffalo are increasing, but elephants are stable or decreasing, the illegal off-take being 20-30 elephants annually.   This off-take is mainly done by local village hunters using muzzleloading guns or rifles obtained illegally from police and other officials.

FIGURE 1

MODEL FOR ANNUAL RANGE MANAGEMENT DECISIONS BASED ON PERCEPTION OF SEASONAL CARRYING CAPACITY
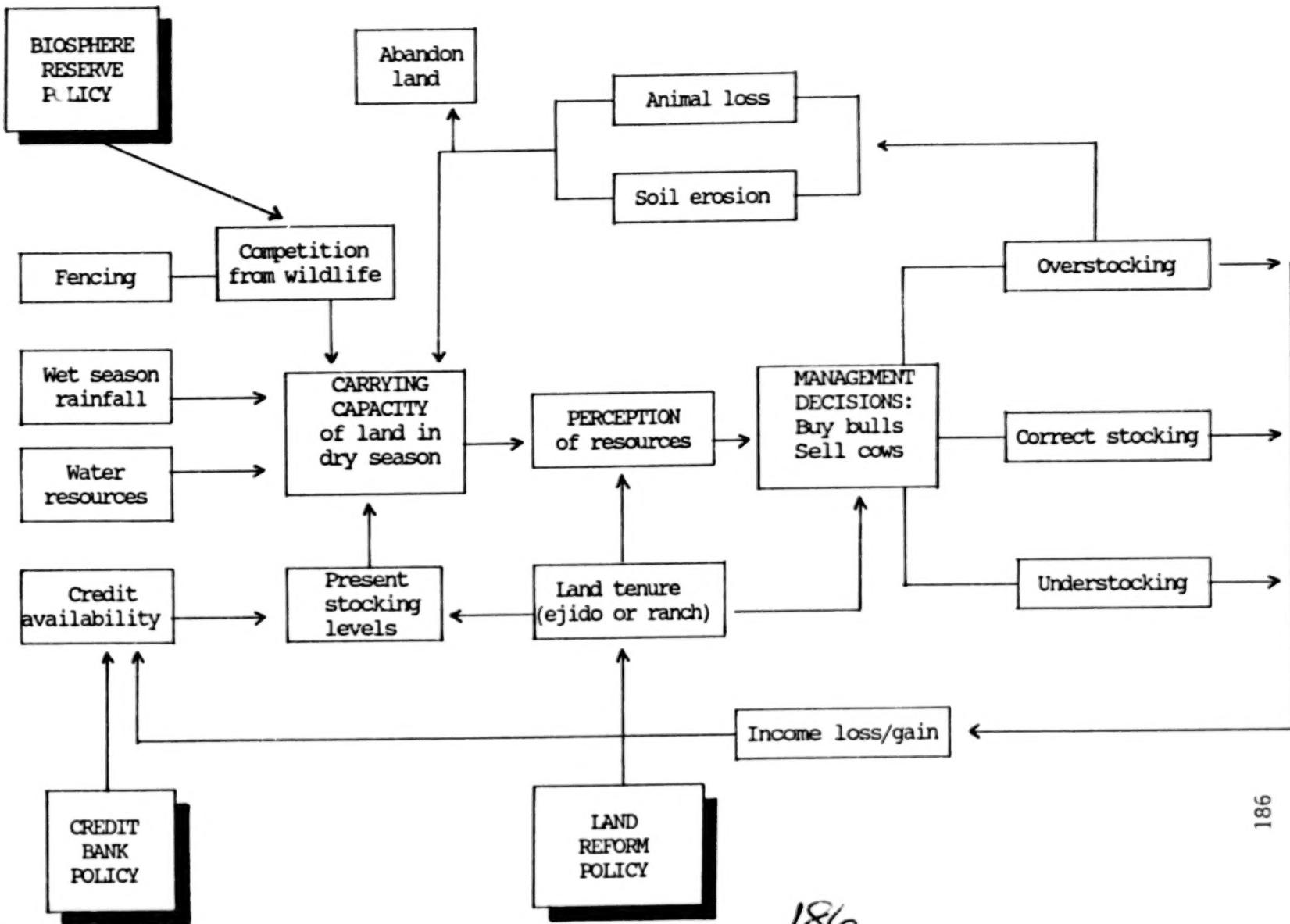
The conservation agency is financially constrained and maintains nine game scouts in the area in two camps supervised by a warden at a nearby national park H.Q. There is a small research unit headed by a professional officer. The area is undeveloped; it has a few dry season tracks but is inaccessible to motor transport for seven months of the year. There is no tourist accommodation and there is little prospect of developing a significant tourist traffic because of the remoteness of the area and the lack of outstanding attraction.

Sport hunting has been attempted as a form of use with mixed success, with indications that illegal hunting increased simultaneously, possibly because local people resented exclusive use by wealthy foreigners.

The proposal now put forward is that hunting licenses should be allocated by annual lottery. The proposal here refers specifically to elephants but it could apply equally well to all species. The lottery would be open to all residents of a defined area surrounding the reserve. This is the eligible public. Applicants would pay a relatively small amount (say US $1.00) per ticket. A relatively large number would be offered (say 5,000) by the conservation agency. The agency would allocate a quota of bull and cow elephants each year (likely to be in the vicinity of five each).

Lottery winners would by winning acquire a license giving them the right to make use of the elephant by any means at their disposal, for example by hunting it themselves, by hiring a hunter to shoot it for them, or by selling the license to the highest bidder, i.e., a local hunter or an external hunting company for use by a sport hunting client. The license holder would have ownership of all products, i.e., ivory, meat, skin, etc. He would be obliged to inform the agency of the precise location of the carcass to enable it to be identified, aged, sexed, etc. The conservation agency could assist license holders by hunting the elephant (for a negotiated fee) and acting as marketing agent for the various products (for a negotiated fee), as well as assisting with license sales to sport hunters on request.

The reasoning behind this proposal is that the system would give the local population a direct interest in the game reserve and its wildlife populations. It could generate a variety of economic and social benefits, through direct income from products or by sale to sport hunting companies who would also employ local trackers, camp staff, etc. This would probably be the most beneficial course financially. Hunting could also supply recreation and prestige. The agency itself would gain revenue from the sale of lottery tickets. The ultimate hope is that, as a result of these benefits there would be social pressures tending to reduce illegal off-take and to reduce demands for excision of land from the game reserve. These trends, if they took place, would allow the wildlife populations to increase (thus increasing the quotas and hence local benefits) and would reduce the costs to the agency of law enforcement and public relations. In short, it would reduce the conflict between the interests of conservation and the short-term economic interests of local people, thereby making the achievement of conservation goals cheaper and easier.

The question posed to the workshop was: what does the agency need to know to put this proposal into effect, control it, and decide whether it has been sufficiently successful to continue? This requires identifying the significant biological and socio-economic factors (including government and nongovernment bodies) involved and relating them by a flow diagram depicting causal interactions.

3. RESULTS AND DISCUSSION:

The flow diagrams produced by the four workshop groups are shown in Figures 2-5. The exercise generated considerable enthusiasm and a wide range of approaches, perhaps exaggerated by the fact that few participants had much experience of this type of flow diagram or conceptual model.

FIGURE 2
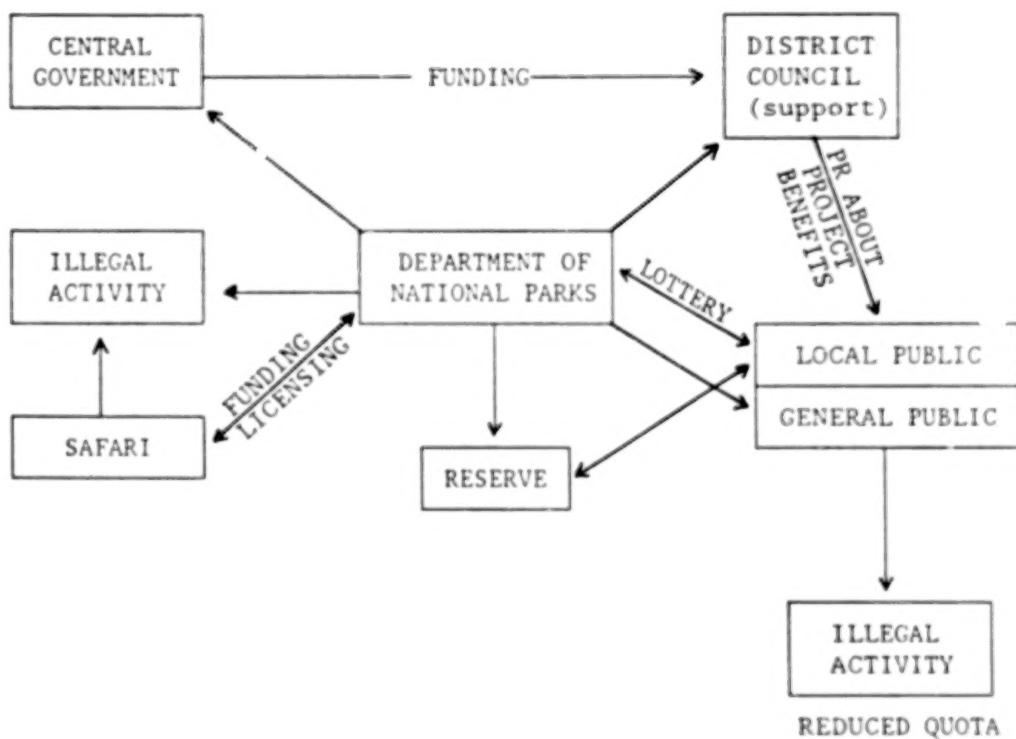
FIGURE 3
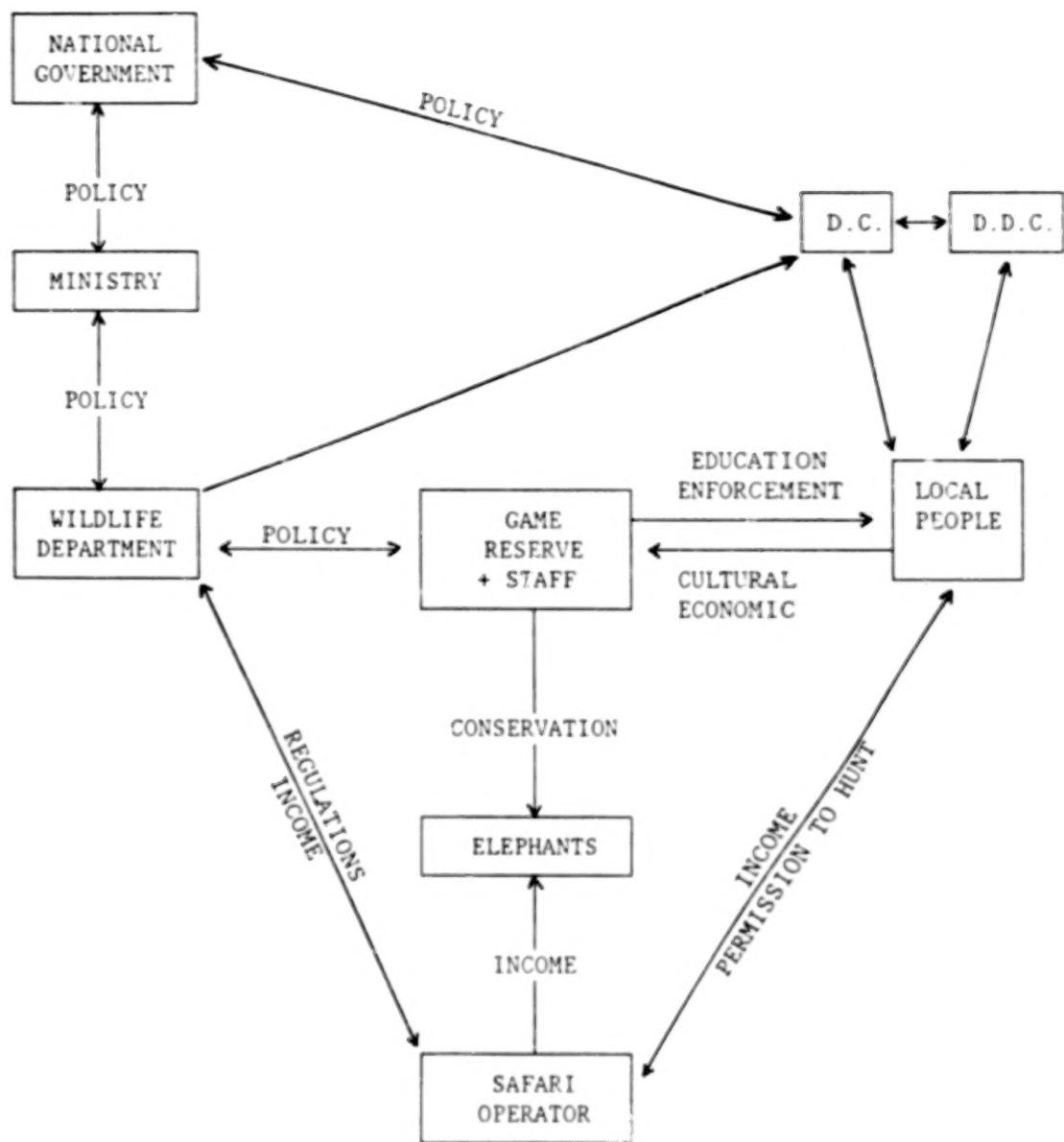
FIGURE 4
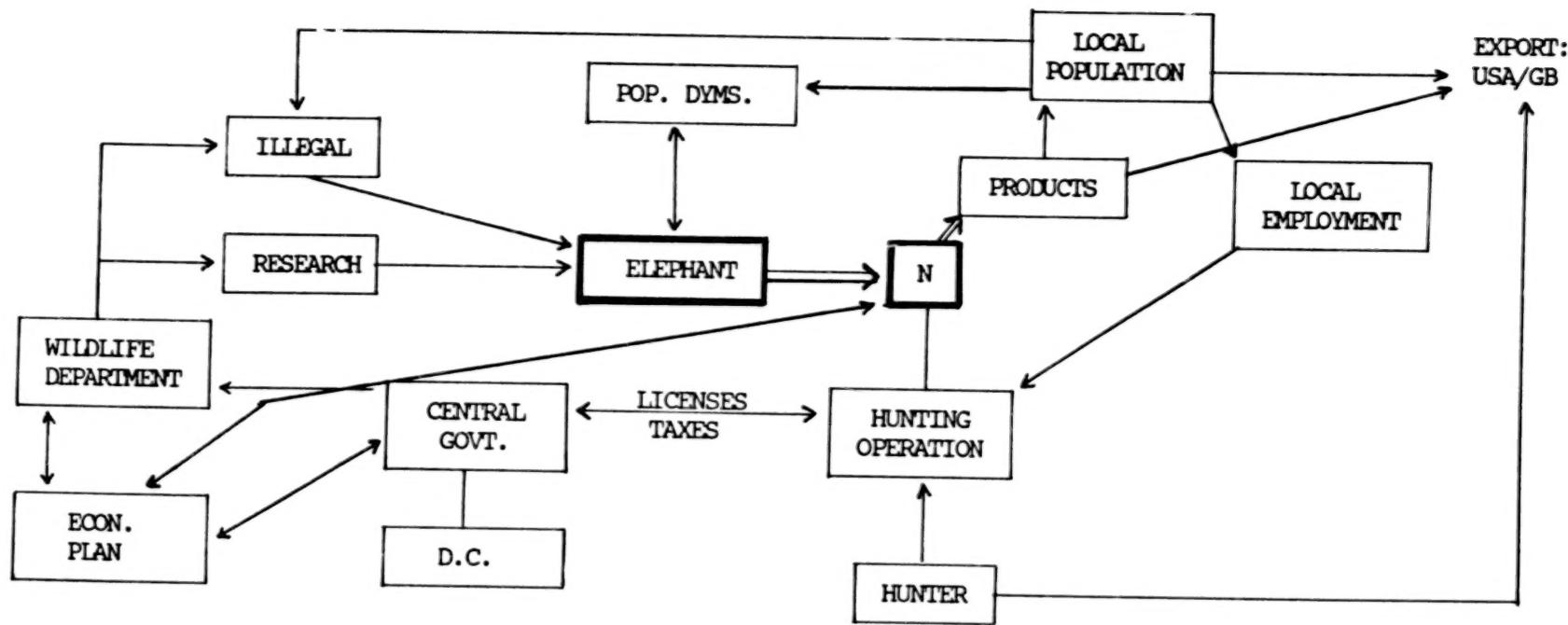
FIGURE 5
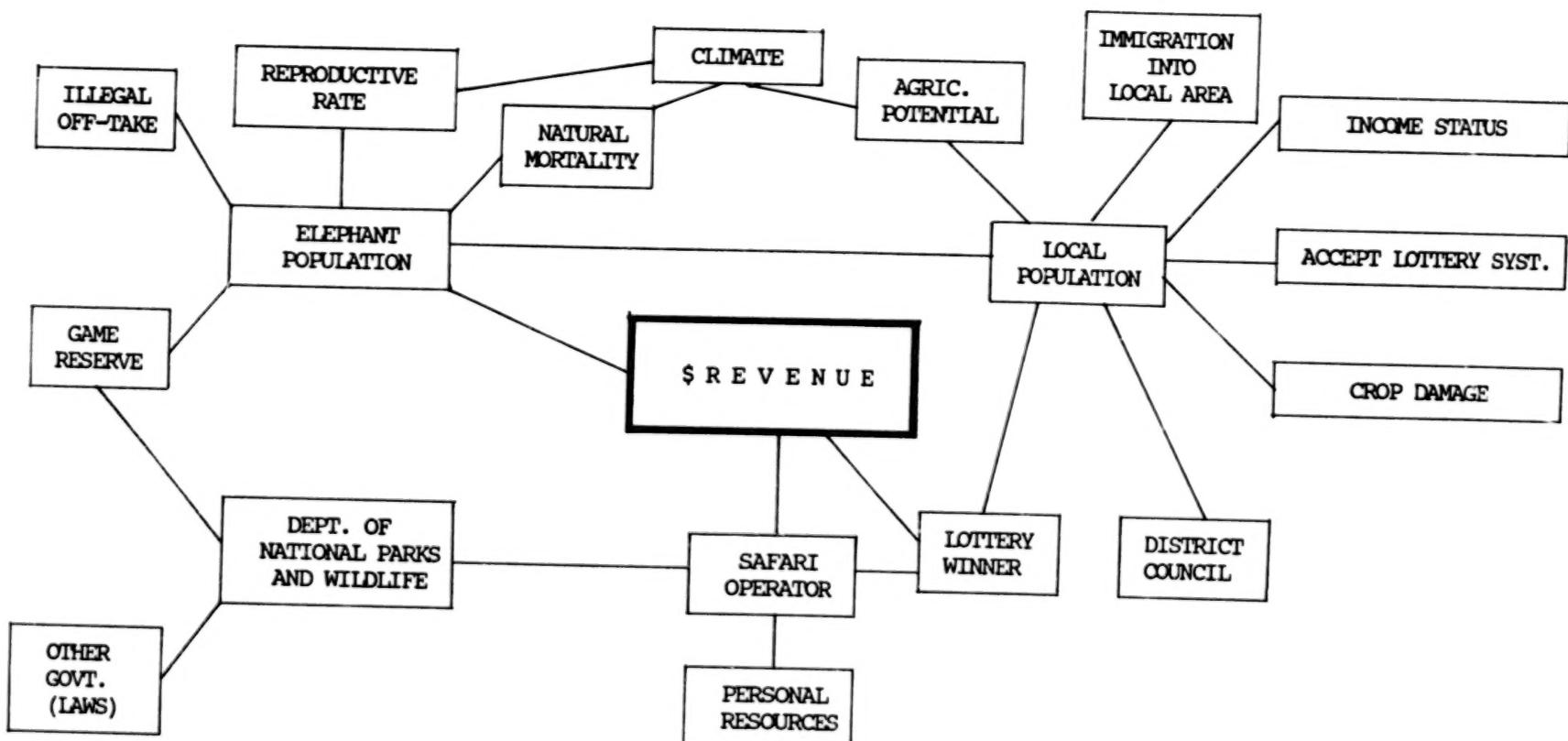
The main point that emerged, and for this alone the exercise could be rated a success, was that in all models, the biological features of the reserve made up a comparatively limited part of the model, while the major components in each case were various government and nongovernment bodies and the flow of money and influence between them.

Figure 6 shows a flow diagram constructed by the two senior coauthors (R.B.M. and I.S.C.P.) at the workshop. It shows the benefits of considerable experience in modelling and computer programming, and provides a simplified outline of a workable model of the hunting lottery proposal. The advantage of this type of model is that at a later stage, each box may be expanded and its internal relations dissected in detail. Post-workshop thought on this topic has suggested to us that the Martin-Parker model is too simplified to give realistic guidelines to the conservation agency on what it needs to know and the decisions it needs to make in order to initiate and evaluate the lottery proposal. We therefore here attach a flow diagram constructed by the junior coauthor, R.H.V.B., who happens to be compiling these notes); the diagram is shown in Figure 7.

The first point is to distinguish between a model of the information flow (i.e., data, decisions, opinions) needed by the agency to initiate and assess the scheme represented in Figure 7, and a model of the actual working of the scheme discussed later.

Figure 7 represents the required information flow given a minor research capability of the agency. Points to note are as follows:

a. The scheme needs a clearly defined objective against which to evaluate success or failure. Our criteria for success are:

   (i) The financial costs directly attributable to the scheme should not exceed earnings;

   (ii) The index of elephant population size should show an increase within five years;

   (iii) The indices of illegal and natural/unknown mortality should show decreases within five years; and

   (iv) The index of pressure on land should show a decrease within five years.

b. The technical information required, therefore, corresponds to the above definition of objectives. Data required are:

   (i) A detailed accounting of costs and revenue directly attributable to the scheme;

   (ii) An index of elephant population size (i.e., from aerial survey, dropping counts, ground census, sighting rates, etc.);

   (iii) A tally of elephants killed legally by licensed hunters and crop protection shooting;

FIGURE 6
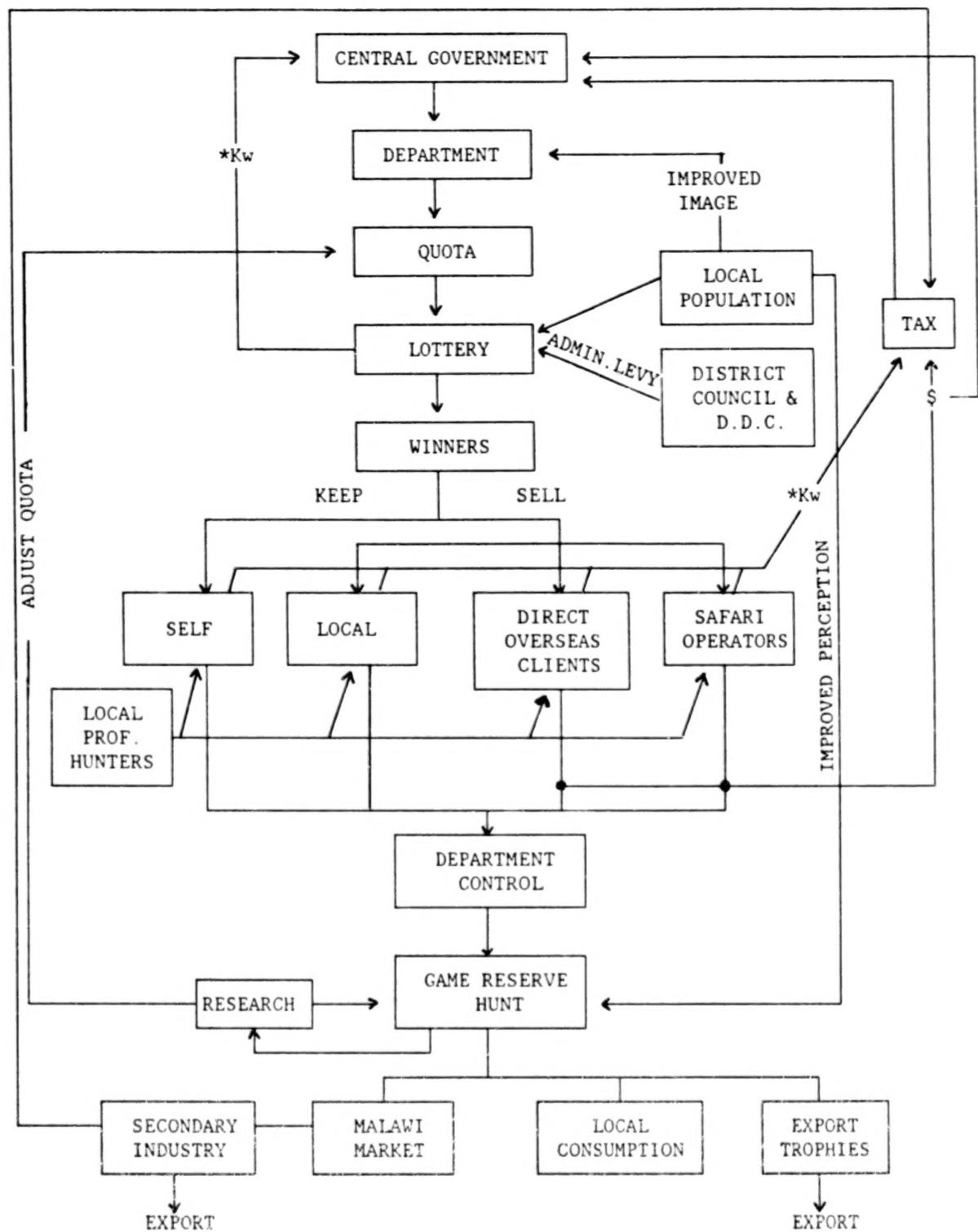
*Kw = Malawi Kwacha

MARTIN/PARKER

FIGURE 7

A model of required information flow to operate and
evaluate the lottery scheme
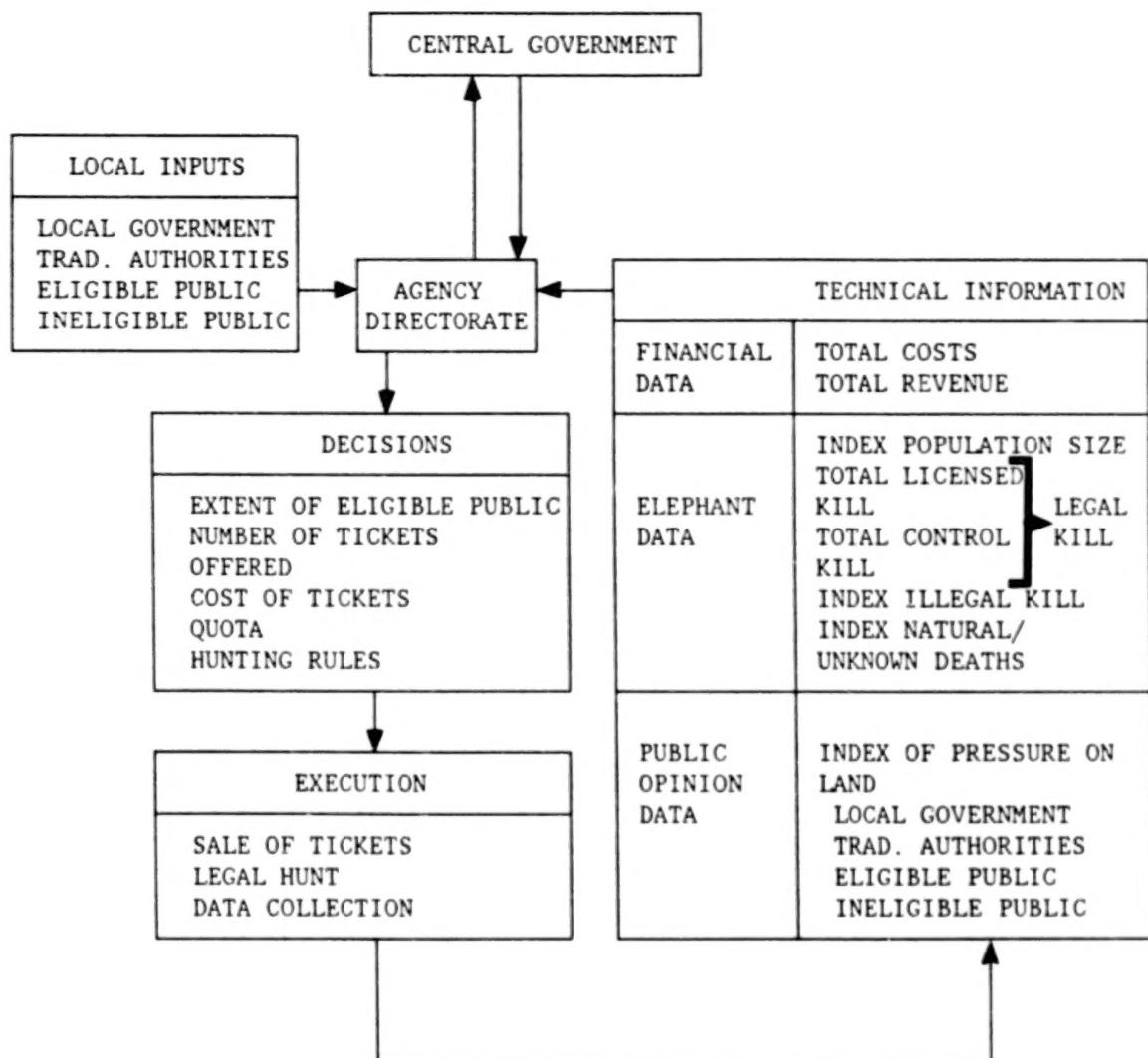
(iv) An index of elephants killed illegally, derived from a patrol report system as outlined in Chapter 22;

(v) An index of natural and unknown cause mortality derived by the same means. The presumption is that both are linked to the rate of illegal activity (see Chapter 22); and

(vi) An index of political pressure to excise land from the game reserve derived by opinion evaluation as outlined in Chapter 30. Local government, traditional authorities and the public eligible and ineligible for the lottery are treated separately to obtain an opinion spectrum and a cross-check.

c. The decisions required from the agency directorate are as follows:

(i) The limits of the eligible public to whom lottery tickets will be offered;

(ii) The number of lottery tickets offered;

(iii) The price of tickets;

(iv) The size and composition of the quota; and

(v) Hunting rules specifying methods, times, party sizes, etc.

d. In making these decisions, the agency directorate will take into account input from:

(i) Its own policy structure;

(ii) Central government;

(iii) Local opinion groups, including local government, traditional authorities and the potentially eligible and ineligible public; and

(iv) The technical information channels listed in b.

e. The above is all that is required to operate and evaluate the scheme. It is unnecessary to obtain information on the details of the transfers of the licenses, so long as each legal kill is identified in relation to a particular license. Further objectives and rules may be imposed by central and local government bodies, such as a levy on ticket sales, taxes from earnings from license users and foreign exchange requirements. If so, appropriate administration and information channels must be established and costed. These are not indicated in Figure 7.

The second type of model, would represent an attempt to outline the causal mechanism of the bio-socio-economic system; it would be intended to answer not only the question; "Does the scheme meet its objectives?," but, also, "How and why does the scheme meet/not meet its objectives?" Can any

components be influenced to improve the scheme's performance?" This type of model is far more complex and requires a much greater research capability to put it into practice. It is highly unlikely that this level of research effort could be supplied within the financial framework of the scheme, so that the development of this type of model would probably have to be subsidized by external funds, either from the agency or elsewhere. Preliminary consideration of what is involved indicate a level of complexity too great to be entered into here.

We conclude, then, that the hunting lottery exercise provides a good illustration of several themes of this workshop. Firstly, all the models devised are essentially feedback models, by which information collected on performance is fed back to the decision making level; this is the essence of adaptive management. Secondly, it makes the point that such a system can only operate in relation to a clearly defined objective; thirdly, it emphasizes that research, better termed the technical branch, needs to concentrate at least as heavily on socio-economic as on purely biological considerations; and finally, it embodies the principle that the costs and problems of conservation are a function of public attitudes so that a primary objective must be to integrate the interests of conservation and the public.

SECTION 3

WILDLIFE - HUMAN INTERACTIO

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CHAPTER 13

THE NATURE OF THE INTERACTION BETWEEN HUMANS AND WILDLIFE

BY

I.S.C. PARKER

1. INTRODUCTION:

One of the strangest beliefs of the twentieth century is that wildlife in its holistic sense is necessary for human well-being. Embracing all life that is not tame, ranging from microscopic fungi to forest giants and zooplankton to elephants and whales, wildlife encompasses many forms whose very existence is inimical to our survival. The organisms that produce the diseases of bilharzia, malaria and syphilis--to name but three--are forms of wildlife that cause people in their millions untold misery every year, and there are many more. Annually, wildlife in both its micro and macro forms inflicts enormous losses upon man's agriculture and nowhere more so than in Africa. Crop losses may run as high as 40% of all that is planted. No doctor or farmer is in any doubt that a very substantial array of wild plants and animals is utterly unnecessary to human welfare. All this is so obvious to the person in the field that unchallenged acceptance of the belief in conserving all wildlife is disturbing. It has come about in large part through Europe and North America's populations being overwhelmingly urban and academic and about as far removed from "natural" reality as it is possible to be this side of Heaven. As many Peace Corps volunteers are drawn from this milieu and, through youth and inexperience, imbued with a very unrealistic conservation outlook, the aim of this paper is to call for a little logic on the matter. It is presented as an essay rather than a scientific report.

2. THE APPROACH:

As in Parker (1984), much herein rests upon an assumption. It is that as the resources within all ecosystems are finite, one species within any one of them can only increase numerically at the expense of other species within it. These finite resources--which include space, solar energy, water and both geological and aerial nutrients--determine each system's potential to produce and support life, the potential biomass. This potential can be apportioned between different forms of life in a vast array of combinations including plants and animals.

3. DISCUSSION:

One of the most striking ecological forces to make itself apparent in this century (and probably before) has been, and still is, human increase. Between 1970 and 1980, Africa's people increased by some 79,000,000. Assuming an average live weight of 50 kg, this represents a rise in human biomass of just under 4,000,000 tons. Between 1980 and the year 2000, it would not be unreasonable to expect a further increase of around 230,000,000 (based on an annual increase of 2.5% and a 1980 population of c. 360,000,000 (Parker 1984)). In terms of biomass, this increase will be of the order of 11,500,000 tons.

Humans are not primary producers and occupy positions relatively high up the food chains that support them. Thus, for every kilo increase in human biomass, there must be an associated increase further down the chain. Because of the inefficiencies in conversion, the increases needed at the lower trophic levels will be greater than the end human product. For illustrative purpose only, assume that it takes 10 kg of herbage to produce 1 kg of beef carcass and 3 kg of beef to produce 1 kg of human gain. Each

kilo rise in the human population calls for a 33 kg rise in the supportive biomass. Where humans subsist off vegetable crops directly, cutting out an intermediate animal, obviously different conversions will apply. Here innate inefficiencies in digestive conversion are greatly augmented by problems connected with the technology of growing crops, storage and food distribution. Added to all this are the vast weights of cash crops-- timbers, fibres and the likes of tea and coffee--which are not necessary as food, but nonetheless essential to human society. While the detail is far beyond my immediate reach, the salient point is that for every kilo increase in human biomass, there must be a far larger increase in the supporting links in the chain. Thus, the 11,500,000 tons increase in the human biomass expected in Africa between 1980 and 2000 will be produced by a vast increase in the supporting livestock and vegetable crops. The precise order of this increase may take considerable research to establish, but it does not seem unreasonable to postulate that it could exceed the human biomass increase by 100 times, i.e., be more than 1,000,000,000 tons. And whatever the increase is, that represented by humans and their supportive species will come about at the expense of Africa's wild estate. While conservation is unlikely to influence the order of the loss to the wild, it may be able to influence what components of the wild go or spread the loss in such a manner that as wide a range of species survive as possible.

Another slant on the relationship between humans and wildlife is perfectly apparent from appreciation of what wild means. By definition, it pertains to that which is uncontrollable and unmanageable. Human welfare and the very essence of civilization rests upon control and management of our environments. Living in a truly wild environment is a basically disagreeable state (recall, this discussion considers man in the context of a species and not from the individual's or the romantic's point of view). The situation in which the western conservationist enters the "wild," lives there by choice and is able to withdraw from it at whim, is not truly experiencing wildness. Remember that Henry David Thoreau (1854), a founding father of American conservation, used to walk into Concord (Mass.) every day to buy a newspaper and, in fact, abandoned his Walden experiment in less than two years.

For a white American, a walk after dark through the streets of Harlem may approximate real wildness as experienced by the rural African who has no option but to live cheek by jowl with large, uncontrollable, unmanageable animals and plants. Visitors to national parks may see the components of wild nature but, through the very act of being there by their choice, having the ability of withdrawing from the scene when they wish to and having livelihoods that are immune to wild influences, they do not experience a wild existence. An analogy may make the point more strongly. Mountains, per se, are not dangerous--except for those who climb them. And for those who choose to do this, they can be very dangerous indeed. However, it is entirely their option as to whether they pit themselves against the dangers. They do not have to live out their lives roped to cliff faces or dangling in space. The wild world is like a mountain. To the developed people it can be viewed from afar; climbed or walked upon by those who care to do so, but through its distance from their normal lives is no threat to them. However, there are also people who perforce live with their kin upon its crags and in its shadows. Without the option of withdrawal, they have

to survive the constant dangers, suffer the frequent losses and live in highly unpredictable circumstances. To them, the wild is something to be feared, to be placated, to be modified in whatever manner possible to reduce its threats and to make it more stable. Of course, they can appreciate its beauty in moments of calm, but such appreciation cannot outweigh the measures that they have to take to survive. It is in this light that the western conservationists' endeavors to educate rural Africans to "appreciate" wildlife, to "lead" them into tacit acceptance of risk, constitutes such an affront to the intellect. It also exposes a great gap of ignorance in appreciating what wild means.

Given the finite resources of ecosystems and that mankind only betters its position or increase its numbers through wresting these resources from other forms of life, and given that a civilized, developed human society can only exist in human dominated and controlled environments, the fundamental relationship between humans and wildlife is hostility. The competitiveness between living plants and animals within any ecosystem ensures, as any farmer or rancher will confirm, an unending struggle to hold onto that component of the system's potential biomass that he has been able to monopolize. Collectively, the most competitive wild elements arrayed against us are referred to as pests, vermin, parasites, weeds or diseases. Failure to appreciate or understand the competition and wide hostility that characterize the most basic relationship between humans and untamed life makes pragmatic conservation difficult.

Relative to man, all life can be roughly allocated into three classes:

a.   Servile,

b.   Neutral, and

c.   Hostile

Servile species are those upon which human life depends. They constitute the whole spectrum of domesticated plants and animals as well as the ill-defined but substantial range of facilitative forms (e.g., soil bacteria essential to plant growth) that can only be controlled crudely by man in his current state of knowledge.

The neutral species are those that can live within human designed niches, using aspects that are beyond man's ability to use directly and thus not competing with him. A vast array of insects and birds spring to mind in this category.

The hostile species are those that compete with humans directly, consuming what they or their servile species would otherwise use, parasites and the organisms of disease.

These categories are not fixed and a species' placement within any one depends on a number of factors such as the land uses applied to an area and, even more, upon human density. Thus, with hunters and gatherers, there may be no domesticants at all, but in view of the huge array of plants and animals eaten, a large portion of what is wild will be servile. A far bigger proportion will be neutral and a relatively small sector

hostile. The latter will largely be the organisms of disease and, occasionally, a predator that takes up man-eating. While hunting and gathering may have been the longest-running way of human life, it seems to support only very low human densities, hasn't given rise to any civilization and, in as far as modern land use is concerned, appears to be of academic interest only. Such examples as still exist seem to be disappearing quickly.

Pastoralists take a quantum step away from the low ecological profile of the hunters and gatherers. Their lives depend directly upon one or several servile domesticants and, in as far as they are able, upon modifying habitats to the point where primary production is through plant species that the domesticants can use. In the main, this means producing grassland. Game ranching is an endeavor to broaden the spectrum of servile species. It is worth noting that a species that may be facilitative at low pastoral densities becomes hostile at higher pastoral densities. Thus elephants have been reported widely as opening up woodland, creating grasslands and eliminating tsetse (*Glossina* sp.), e.g., Laws, *et al.* 1975 and Ford 1966. Range is thus made available to men and domesticants and elephant presence is advantageous. However, when pastoralism is undertaken at the higher human densities typical of modern ranching (densities here may not be on the land directly, but in distant urban centers and represented by proxy in the form of capital invested and their consumption of the resulting animal product), elephants become serious nuisances. Not only do they compete directly for forage and water, but destroy infrastructural development--piping, fencing, etc. Similarly, neutral species are more abundant at low pastoral densities but are edged over into the hostile category at higher levels when they compete for grazing and are vectors of disease, etc.

Crop cultivation raises the competitive stakes far above those presented by pastoralism. Replacement of almost all life, except beneficial soil organisms with a few chosen domestic plants, represents the most complete monopolization of ecosystems attempted by man. It is through this form of land use that man has achieved all the material pinnacles of civilization. It also follows that it engenders the greatest hostility from wildlife (urban environments excepted). Again, the greater the densities of humans involved, the greater the areas cultivated and the higher the proportion of species that are forced into hostility. Because competition for space is so fundamental an element in the human/wildlife interaction, there appears to be a relationship between size and hostility and the subsequent order of displacement. Hence, large forest trees and elephants go before knee-high shrubs and hares.

All the foregoing is largely self-evident. Despite this, it has been consistently ignored by conservationists generally in Africa and elsewhere. The hostility between man and what is truly wild has been overshadowed by North American and European experience in which ecosystems have been so radically modified that all the more obviously hostile elements have been displaced or relegated to areas where they offer no threats. These ecosystems no longer represent nature as it was without man, or when he was a subordinate rather than dominant component of them. A great deal of what is said to be wild in them is not. In Britain, for example, a country graced by numerous woods and copses, there is virtually no "natural"

woodland. Almost all that there is, is where it is and what it is through deliberate human planning and planting (Thomas 1975). Albeit through the crude practices of sport-hunting, all of Britain's and most of Europe's large mammals are present through management. Hostile interactions as when boar or deer damage crops or forestry interests are counterbalanced by recreational values. Be it noted, however, that the hostile interactions seldom reach the culminate point where the animals can kill humans. Implacably hostile elements of the original fauna--wolves and bears--are widely absent and, while it would be a simple matter to reintroduce them into most parts of their former ranges, there is little chance that society would countenance such moves. The situations in both Europe and North America do not serve as examples of conserving original ecosystems. Highly modified and controlled they do, however, serve as examples of where African conservation might be heading. That is toward a comfortable environment for man: one in which Wordsworth, were he still around, would not have to saunter about with a .458 under his arm or risk sitting upon a scorpion!

Africa, through the very complexity of its ecosystems, presents management (taming) issues that have never been considered in the "developed" world. However, certain ground rules apply. The hostility, so strong a feature of the human/wildlife interaction, is rooted in immutable biological law; in the interspecific competition that, in large part, is one of the two main engines of evolution (the other is, of course, cosmic change). Human increase can only come about through even greater expansion in the pyramid made up of servile species. This, unavoidably, means a corresponding decrease in the wildlife estate. Criticizing Africans for failing to prevent this, trying to "educate" them to prevent it, or creating draconian legislation and punishment in trying to stop it, will only result in stress within the human communities. Such actions will have little impact on the displacement of what is wild. The Peace Corps, through its commitment to bettering the human condition, would do well to come terms with the realities of conserving in Africa. The pseudo-ecological theory that has permeated the northern temperate zone melts like snow on hot rock when confronted by the elemental biological facts prevailing on the continent. The essence of pragmatism in this field is in determining what is possible; of predicting human densities, the land uses that will support them and what wildlife will not be hostile. As much as deciding what to preserve is an understanding of what not to preserve. Heresy may be back in the USA, but as has been pointed out by such thinkers as Siegfried (1984), some species may well be beyond realistic conservation. And above all, those who seek to assist conserving in Africa, need to be humane. Instead of the dictum "Thou Shalt Not" so deeply espoused in developed urbania, the approach most likely to produce a lasting result is that which confers greatest benefits. If a park set up to protect rhino can, at no cost to its purpose, provide firewood, honey, medicinal plants or a fish catch for local people, then why gratuitously deny them these resources? Integration with other land uses, seeking maximum benefits and, above all, pragmatism in accepting the biological relationship between man and what is wild, are attributes the Peace Corps should foster.

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A MISCELLANEOUS NOTE

THE UNREASONABLE SEPARATION OF FORESTRY
FROM WILDLIFE CONSERVATION IN AFRICA

Students of game conservation in Britain and in Europe will be aware of the long association between forestry and wildlife protection. It stretches back for centuries and for the most part, foresters have been the principal wildlife conservators. The connection exists in North America, though to a much less pronounced degree. With European imperialism in the last century, the connection between forester and wildlife conservation was introduced to India. It is still apparent in Francophone Africa, where conservation comes under the Departments of Water and Forests. The close connection between the two land uses has obvious grounding. It is, thus, somewhat odd that in East, Central and Southern Africa a wide separation has evolved between them.

The primary reason for this lies in the form that forestry has taken. Concentrating upon highland forest areas that are short of valuable hardwoods, attention has been focused on cultivating fast-growing commercial softwoods--predominately temperate zone conifers and Australian eucalyptus. While these have met the economic goals for which they were planted, they formed such alien habitats for African flora and fauna that they were very deficient in conservation value. For this reason wildlife conservation became widely separated from forestry. As much of the design for modern African conservation came from the countries in which the process took place, the gap has been introduced far more widely than is necessary.

In the western and central Africa lowlands where tropical hardwoods are abundant and form the basic of commercial forestry, and where exotic conifers and eucalyptus do not do well, the separation of forestry and wildlife conservation is largely pointless. The commercial forest environments, being composed of indigenous flora and timbers, can, at the same time as they grow timber, afford sanctuary to a vast array of tropical forest life. As Francophone Africa is poor in the montane biomes of East, Central and Southern Africa and rich in lowland hardwood forests, the connection between forestry and wildlife preservation that is so prominent a feature of Europe, still persists. There is no good reason why this association should not be developed and strengthened in the interests of integrating conservation with other land uses. A prime example of how this can be done successfully stems from Uganda Forest Department policy from far back in the colonial era until the advent of Idi Amin and institutional chaos. A valuable example of planning and integration is presented in the working plans that existed for every Ugandan forest. If they can be obtained, they are recommended reading.

CHAPTER 14

WILDLIFE HUMAN INTERACTIONS

BY

R.B. MARTIN

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In the early draft agenda for this workshop two topics were outlined: *The problem of pressure on wildlife resources due to human population increase*, and *Wildlife-human interactions outside protected areas*. I decided to combine them into a single paper because it seemed to me that they were almost identical. In many parts of Africa, Zimbabwe included, there are significant wildlife populations outside protected areas, and it is mainly towards these resources that this talk is aimed. With powerful enough policing, protected areas can be secured, even if there are a few social injustices along the way. Ultimately, however, the long-term future in Africa depends on the relationship between humans and natural resources both inside and outside protected areas.

A great deal of what I will talk about here has been taken from separate papers by Harold Brookfield, Brian Spooner, Anne Whyte, Colin De'Ath, Ervin Zube and S.C. Dube in a special issue of the *International Social Science Journal* published by Unesco entitled *Man in Ecosystems 93*. The synthesis is mine, and I have mixed statements from the authors in such a way that it would be hopeless to attempt to give references throughout the text. It may well be that you are all thoroughly familiar with this publication, and if so, I apologize for boring you. However, it gave form to a number of ideas running through my mind and in many cases expressed them far more elegantly than I could have done. Some of the ideas I found revelationary if not revolutionary. I was amused too, to find that the social scientists regard ecology as an exact science and bewail their lot of having no fundamental tenets, basic texts or even a consensus on how to approach social and cultural problems. If once again you feel that I am diverting the course of this workshop into another discipline, I apologize. However, on this occasion, I feel that some of the concepts involved are vital to the topic concerned.

1.   INTRODUCTION:

Right at the start, let's deal with the conceptual bias in the original title of this topic (the problem of pressure on wildlife resources due to human population increase and land development). Ecologists see environmental issues as the human impact on a resource base. The human component is a sort of "black box," the processes within which are unknown, and only the output can be measured. This is not much use in ecosystems where man is dominant. The social scientists, on the other hand, are only capable of illuminating the man-to-man relationships, and cannot penetrate far into the man-nature relationship. Unfortunately, most research is perpetuating the dichotomy--the very opposite of what is most needed at the moment.

Studies involving humans and the ecosystem seem to fall into three categories:

a.   Those where humans are seen as biological organisms--natural components of the system. This is a natural scientist's model which ignores the social and psychological dimensions of humans.

b.   Those where emphasis is placed on the impact of humans on natural systems. Such studies are unidirectional and ignore the fact that the ecosystem also impinges on humans.

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c. Those where human biology and behavior are incorporated at the outset into a conceptual framework along with physical and biological nature. It is this sort of study that is significantly absent from the record, with a very few exceptions.

At the extremes we, humankind, may see ourselves as the slaves of nature or its masters. We can be the stewards responsible to a higher authority; we can be partners with nature in a larger grand design; or we can make use of nature to differentiate and organize society--to generate differences in wealth, power and status. A primary function of nature is as an *orderer* of human society (this fact is insufficiently appreciated), and this interferes with its more obvious role as a provider of resources on which we depend.

We are far from being the first civilization to perceive that our environment is at risk: most primitive tribal societies feel the same. The dangers are naturally not identical. Where we see overpopulation as the threat, they see underpopulation. But they pin the responsibility in exactly the same way as we do. Human folly, hate and greed are the main factors putting the environment at risk. When land developers argue for a project, time, money, God and nature--in that order--are the trump cards plunked down to win an argument (Douglas 1975).

Ecologists unconsciously tend to impute the causes of environmental problems to the activities of people who are socially or culturally different. In *Man's Responsibility for Nature*, Passmorre (1974) has defined the difference between an ecological problem and a problem in ecology. A problem in ecology is a purely scientific problem (we do not understand something). An ecological problem is a special type of social problem (although scientists might have one suppose otherwise). It is labelled a problem not because it is hard to understand, but because we believe we would be better off without it.

2. TRADITIONAL SOCIETIES:

I will outline some of the characteristics of traditional societies which are vital for us as scientists to understand if we intend ever getting involved with the human side of ecology in Africa.

Production in the peasant's eyes is not directed towards a market economy, and his social objectives differ from those of a national bureaucracy. For him, technology and social life are related in such a way that if one is disrupted then the other disintegrates.

Man and his cattle are seen by the World Bank, the IMF, and most rangeland ecologists as the biggest threat to future security on the continent; yet every cattle owner wants his herds to be as large as possible. Not only are cattle food producers and capital, but they are a means of storing wealth, their offspring generate interest, and they play a vital role in social relationships, weddings, and friendship. The only real wealth is in social ties, and the only means to it is through cattle. There is no other way to acquire wealth or to store it.

The traditional pastoralist does not draw a distinction between the formal organization for production purposes (e.g., a business organizational structure), and the informal organization of personal relationships with family and friends. To cope with problems that arise in such situations, he has modes or conventions of behavior. In our formal structure, which traditional economies lack, we will view their problems negatively--we think that they are hindered by constraints--that their social relations affect their productivity--but our explanation is untenable in their society. To them production and social relations cannot be separated.

In searching for approaches to bring about change, if we appreciated their flexibility in being able to generate new behavioral or structural poses, we might find a positive way to facilitate a new pose for a new purpose. Intervention in this sort of society presents problems least well understood by the ecologist and the development planner. For years the anthropologists have talked about social imbeddedness of traditional technologies, but they too have been unable to translate them into recipes for inducing change in an ecologically desirable direction.

Communities endow their environments with credibility. Any tribal culture picks this and that to fear and sets up its demarcation lines to control it. It allows people to live contentedly with a hundred other dangers which ought to scare them out of their wits [for me New York traffic is the ultimate scare]. Discriminating principles come from social structure. An unstructured society leaves us prey to every dread--as all the veils are stripped away, there is no right or wrong. The task is to recognize each environment as a mask and support for a certain kind of society. It is the value of this social form which we must study--as much as pollution, degradation or any other ecological problem (Douglas op. cit.)

The plight which faces rural communities in remote areas has been well-described by Blaikie (1981). Differentiation amongst the peasantry creates more marginal cultivators; the surpluses extracted from these cultivators through adverse terms of trade, wage employment, rent and other mechanisms puts an ever larger sector at risk. Such people tend to occupy, or be driven to occupy, marginal land so that the discount rates on their investment are raised to the point at which a short-term return is bought at the price of long-term conservation of resources. Thus soil erosion is associated with social class in the peasantry.

We might ask ourselves not so much "what effects are humans having on resources?" as "how are system changes affecting the communities that live in them?" Instead regarding the peasant communities as showing conservatism in the face of innovation, we could regard their behavior as rational in the face of risk and uncertainty. When we talk about adaptive change, we should ask "adaptive for whom?" What is adaptive for the species or the nation state may well be maladaptive for the individual organism. Adaptation is related to the scale of the system and the perspective of the observer. A traditional society which seems to be maladaptive to technological progress, may appear to itself to be a reservoir of resilience in the midst of environmental degradation.

a.   Land in Traditional Societies:

In Western civilization land is a discrete entity irrespective of what is on it, over it or under it.   It is Real Estate and has commercial value. This is not so in traditional societies.   Land is part of an animate entity, it is host to the spirits of the dead, and the origin of the clan is intimately bound up with the origin of the land which they hold in trust.   Their emphasis is not so much on agricultural mastery, but rather on a symbiotic relationship for subsistence purposes.   The traditional society cannot understand how people can sell land, or allow it to be alienated, for example, for national parks.

Belatedly in Western civilization, governments, international agencies, and private conservation groups are beginning to understand that land is not just a platform to build things on.   The frontier mentality of the last century has no place today.   Feedback from previous unwise land use practices is starting to reach the world public, and there is an awareness that we depend on biological systems using sunlight, soil nutrients and water for biomass production.   The growth of cities has proved that enormous resources are required to sustain urban dwellers, and the per capita growth in cities has given land a new value.   Parks and protected areas can no longer be negotiated for sale in the real estate market.   Ironically, it is only the privileged few who have access to such parks, or can play the role of conservationists.

Land itself cannot be packaged for export, but its products can and ownership can pass into foreign hands.   Even if not directly alienated, it can become subject to the whims of foreign consumption habits.   Land planted for export crops is at the mercy of world markets and does not lead to self-supporting nations.   In Zimbabwe at the moment there is a major drive to export beef to the European Economic Community under the Lome Convention: however, there is a surplus of beef within the EEC and the importing countries are placing every obstacle in the way of our imports. Draconian veterinary measures are being imposed which involve the killing of all buffalo outside national parks and the erection of extensive fences to prevent the spread of foot-and-mouth disease.   In effect, we are making a large part of our country nonproductive to satisfy external measures.

In the same way, a national park whose chief function is to satisfy the international tourist market is in thrall to a fickle mistress.   A far better way to justify such protected areas to local communities is the argument that they are baseline control areas, set aside for future generations, which provide a permanent record of original flora and fauna in the face of surrounding land use changes.   Tourism is a totally secondary function of the area.   Peasant communities will accept this argument far better than that which promises tourist revenue to a central government of which little ever percolates back to them in their remoteness.

3. PERCEPTUAL FRAMEWORKS:

The tendency of the ecologist is to view anticonservation activities of traditional societies as the result of irrational behavior. More recently, people have begun talking about *institutional constraints*--social mechanisms beyond the control of the people themselves which are preventing them from responding rationally or adapting to newly offered ideas and opportunities [The syndrome "I'm depraved on account I'm deprived"]. The idea of institutional constraints represents a step forward, but it may be a false step. It is essentially a negative approach. The constraints are largely in the mind of the investigator who views an ecological problem as one of social intransigence. It is still founded on the idea of the rationality of the investigator and the supposed irrationality of the people who can't see that they are being trapped in modes of ecologically undesirable behavior.

Imbedded cultural values, entrenched attitudes towards people and resources affect the scientist as well as the subject. Development personnel usually emanate from culture with well delineated social hierarchies, and prefer to deal with their own peers, not peasants, [which is what we're doing right now].

4. DEVELOPMENT PLANNING:

Development planners in Africa usually start with the assumption that there are only two alternatives: either things take their course and in the long run, if not the short, get progressively worse; or, production techniques originating from the developed world are introduced on the assumption that people will adapt to them. Neither approach is satisfactory. There is a confusion of the objectives of change with the mechanisms of change.

It is probably axiomatic that all development planners want to counteract degradation, raise the standard of living, and increase the economic benefits to the national economy. Some planners think that the focus in developing countries should be on health, nutrition, and education: others might see these as an automatic accompaniment to unfettered economic growth. Marxists believe that agriculture should be organized on orthodox lines as factories in the fields: but the only place that this has been achieved is in those countries with laissez-faire economies such as the United States. All schools of thought are pretty well beside the point if there isn't the resource base or skills to support their ideas.

I recently participated in a committee which was a "front" for the activities of a Regional Development agency, needless to say from a Western country (one can become quite cynical, and I am, when one sees the procession of consultants arriving in a newly-fledged independent country to solve its problems). In the entire "regional plan" the word natural resources was not mentioned once: the "bush" was regarded as something hostile which had to be tamed before progress could be made. When I pointed out to the planners (whose major recommendation coming out of the report was for five tractors) that the resident villagers obtained more than half of their provenance from the natural resources around them, I was

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viewed as an obstacle to development. It is no good computing the costs of such development (e.g., clearing a forest) in the narrow confines of traditional economists: such costs must be seen in the peoples' own perception of the value of the resources.

Rural communities can be extremely disadvantaged by development which involves extensive land use changes. They have never experienced development on a large scale and have no conception of its consequences. The ecosystems on which they depend for resources can be modified beyond the point of no return, because they do not have the skills to survive in (let alone move smoothly into) the new economic system which is at complete variance with their own.

Most development is an attempt to imitate the patterns set by the industrial nations, and the governments of industrial nations reinforce this attitude by making their aid conditional on the importation of their own technology and equipment. While this may not be a bad thing, it is ironic at a time when the people of the Western nations themselves are questioning the appropriateness of their model. Certain circles in developing nations believe that anything less than slavish imitations of industrialization are unacceptable. Thus, the environmental movement with its emphasis on appropriate technology, resource conservation, population control, energy conservation and the like is viewed as something of a conspiracy by the haves to retain their ascendant position over the have-nots. All of which poses problems for advisors who would gladly opt for alternative development routes so that Third World countries do not squander their resources on outsiders, or consume them too rapidly themselves.

Between the planner and the planned are cultural differences which will lead to misunderstanding and a conflict of interest. It is very difficult to recondition communities unless the planners realize that they must somehow tap the changing priority perceptions of villagers and interpret these in terms of what is happening in a wider world. It is pointless to adopt the approach that the villagers are the problem: rather conceive of the problems a changing world will impose on such people. The spatial and temporal appreciation of a community's problems at the micro-level is very difficult. While it is one thing for the big-thinking scientist to monitor environmental change from a satellite, it is another matter to influence those on the ground who have a far more circumscribed, parochial vision of the situation around them and the direction of change.

Perhaps an appropriate approach to planning in the Third World is to try to harmonize the cultural and economic concerns, recognizing the short-term needs of the present populations and the vital conservation issues for the future. It is inevitable that local populations will have a short-term outlook and seek to enhance their immediate economic situation. It is also likely that the public and private decision makers will be responsive to the immediate concerns of the people, and it is, therefore, vital that a sector of public administration is briefed and supported in the task of long-term conservation.

5. CONCLUSIONS:

I have presented mainly the thoughts of eminent social scientists on the topic in hand and little that I have said is original. However, as the function of this paper is to stimulate discussion on the subject, it is perhaps best that you hear the views of people more experienced than myself.

Unlike tribal society we have the chance of self-awareness--by mere virtue of the fact that we can compare our beliefs with theirs. Self-knowledge is a terrible burden (Douglas, op. cit.) When we are confronted with an extension problem involving a traditional society, perhaps the right approach is to try reformulating the problem according to that society's assumptions. All disciplinary differences, all conflicts in scientist/peasant perceptions and all problems in cooperation stem from the perspective of the perceiver. However, distorted it may appear, that context is real and intractable to the person concerned--as much as the ecological context. If disrupted it will reform, but not to the planner's tune.

For two years (1980-81) I was involved in planning for the Sebungwe Region in Zimbabwe (an area of about 10% of the country). I embarked on the project firmly believing that once we had established the correct land uses in the region, Government would rubber stamp the plan and somehow it would metamorphose on the ground. This still hasn't happened. The planning process taught me a great deal. Firstly, it was obvious that the people had already found all the best arable lands (without any help from the planners), that there wasn't much arable land left (despite politicians' statements made on the basis of occasional aircraft flights over the area) and finally, from interactions with the local communities during workshops, that one cannot impose a plan from the top. The gap between conceptual planning and actually getting something done in the field was vast. Through workshops, we arrived at a point where we had identified the major conflict areas in land use--most conflicts were of the wildlife-human variety--and realized that we had reached the point where regional planning must stop, and its place needed to be taken by a much more detailed grassroots planning exercise. We also realized that this would not be a process of dictating to the locals how their future would be organized, but rather a long protracted process of negotiation, presenting options and providing technical and managerial assistance. There are no shortcuts to the end objective.

The outcome of this work is *The Communal Areas Management Programme for Indigenous Resources (Campfire)* which I hope to present in the second part of this workshop where it rightfully belongs.

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CHAPTER 15

WILDLIFE UTILIZATIONS

BY

R.B. MARTIN

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1.   INTRODUCTION:

I will use Zimbabwe as my cornerstone in this talk, partly because I am familiar with all the aspects of wildlife utilization in Zimbabwe, and partly because Zimbabwe probably uses wildlife in more ways than any other African country. Indeed, Zimbabwe is a pariah amongst many conservationist lobbies for not being pure enough in its approach to wildlife, and not restricting wildlife use to the single elevating experience of game-viewing.

Tourism may perhaps be an adequate justification for the retention of large areas devoted to wildlife in the countries to the north of Zimbabwe, on account of significant revenue earned by prorated areas. Zimbabwe is at a disadvantage in this market because of the higher airfares from the northern hemisphere, and because game-viewing is more spectacular in some of the open plains-type parks of Kenya, Tanzania and Uganda. Zimbabwe has to justify her extensive areas under wildlife (some 12.5% of State Land, and large areas of commercial farming and communal land) in a lot more ways than keeping them simply for tourism.

Our policy is always to prefer the benign (i.e., nonconsumptive) use of wildlife over consumptive uses when this option is open to us. But very often it is not. The legacy of colonialism was far too many national parks in our country (is that heresy) and not enough conservation areas. I mean that very seriously. An area does not have to be a national park in order to promote conservation, and the number of recreational activities that can be pursued in national parks is limited.

Recently our Department has come under a great deal of pressure from a range of lobbies in Government and the private sector to make wildlife earn a greater revenue for the country. Even many sincere benign nature lovers have said to us, "if wildlife can't pay its way, it won't survive." At a crisis point a few years ago, the Board of National Parks considered opening up parks to uses such as limited safari hunting, logging operations and grass cutting. This pressure was resisted. A strong group, mainly amongst our professional ecologists, felt that national parks were not established purely to make money: in the same way as any civilized country establishes museums, art galleries and archives as part of its cultural heritage, and does not expect them to contribute to the national exchequer, so there is a place for national parks.

Having declared an area a national park through an Act of Parliament, a country is committed to certain international standards in upholding the functions of the area, and there are principles that cannot be compromised. Finally, the argument that won the day was that there were significant wildlife areas not in the category of national parks where government had every opportunity to make money out of wildlife, provided it could simply "get its act together"--which it was not doing at the time of the argument.

The important point I wish to make here is that the problem arose from a situation where the vast national parks estate was seen to be contributing too little to the national economy. It would not have happened firstly, if the areas devoted to national parks had not been so large, and, secondly, if we had been pursuing more active conservation

policies elsewhere in the country where there were areas containing wildlife.

The manner in which our national parks were originally chosen had nothing to do with World Conservation Strategy. We did not examine the types of ecosystems in the country or survey the vegetation, and then carefully establish protected areas representative of each type. Rather, the farmers grabbed the land with the best arable soils and best pastures, and when it was all over, the most marginal areas of the country which nobody wanted anyway were put over to national parks. As a result of this process, we no longer have any representative ecosystems in the highveld plateau areas protecting *Brachystegia* communities on deep dolomite soils, and we have virtually lost all lowland tropical rainforest, wherever there has been competition with agriculture. I find it very hard to go along with the holier-than-thou attitude towards national parks (and wildlife in general), which endows parks with some sort of special sanctity, whereas in reality they were a final act of conscience appeasement after the rape of all other land in the country.

Before going on to talk about the different types of wildlife utilization in Zimbabwe, I think it is appropriate to remind ourselves about the goals of World Conservation Strategy (WCS). With the exception of one of the activities to be discussed, none of the forms of utilization in any way transgress the principles of preserving life support systems, genetic diversity, or sustainable use of natural resources--in fact, the opposite is true.

2. BENIGN USE OF WILDLIFE:

I said earlier that our Department will always favor the benign use of wildlife wherever possible. This need not necessarily be at the stage when the benign use starts looking as if it will earn more revenue than a consumptive use: I can't quote the correct figures, but I believe the Amboseli lions, for example, are worth thousands of dollars each calculated in terms of the money paid by tourists to see them--far more than they could possibly earn by being hunted. If the demand is present, particularly among citizens of the country, we will tend to favor tourism, even if it does not seem to be the best economic option. It is difficult to set a price tag on the recreational benefits (here I use the prime meaning of "recreation") to the tired city executive: if he comes back to town less likely to have a heart attack, some expense has been saved somewhere.

As an example of the above: in a recent internal workshop to determine policies for safari hunting in Zimbabwe, it was recognized that parts of the Zambesi River which have for a long time been the preserve of the big game hunters will now be shared with canoe safaris. The demand for this form of recreation is becoming so high that despite the high foreign currency earned by the hunters, we are morally obliged to support the benign use.

But now I have a wicked confession to make. On the whole, I actually find wildlife pretty boring if I am forced to sit and look at it in the conventional way. It's probably a major shortcoming in my character formation, the fact that I can't sit for days on end in a vehicle or hide

watching fascinating wild animals at their daily business. Wild animals are pretty dumb creatures when you come to think of it, with the possible exception of elephants and baboons. If you've ever tried to raise any antelope or carnivores as pets you soon realize that they haven't got the intelligence of the average domestic dog. I tend to suspect that despite the propaganda of how one ought to feel towards wild animals, the average young person cannot genuinely enjoy cruising around a game reserve for any length of time gazing at game through a car window.

I really only enjoy myself when I am interacting with wildlife. You have to make it realize you are there, upset it, kick it, dart it or do something to get the adrenalin up. Recently, I had a long drive through a famous national park, and I must say the game was remarkable: in an afternoon drive between two nearby camps, we had three separate sightings of leopard, two sightings each of lion and hyena, and even saw cheetah. Now I suppose that is what I ought to remember; but, in fact, a few days later I enjoyed a fish poaching trip in the same park with a colleague. As a result of the absolute protection policies in the park, these fish didn't even know what a human being was. I cannot describe the pleasure of sitting down to eat two fat bream--a pleasure totally enhanced by the knowledge that they were illegal.

The point I am trying to make, albeit flippantly, is that the demands for use of protected areas should include opportunities for people to commit suicide with dangerous game if they so wish. It is, in fact, very hard to do so. Young people need to get out in the bush and flex their muscles without a guide holding their hand if they don't want one. Fortunately, in Zimbabwe you can still do this in many parks--but there seems to be a growing feeling that the only way to enjoy wildlife is to be a protected spectator.

3.   CULLING:

It is an irony of conservation policies in Africa that the need to cull arises. I don't propose in this talk to initiate a discussion of the pros and cons of culling. In Zimbabwe, it is a fact of life that I have totally come to terms with, and accept as necessary, given the present circumstances of an exploding population of humans and a conservation structure which presents no other options. The full rationale behind our decisions to cull has been covered extensively in published literature by our Chief Ecologist, Dr. D.H.M. Cumming, and you can refer to his papers if this matter needs to be expanded into a separate discussion.

I must say I didn't always accept the argument for culling. After six years of studying elephant in the Sengwa Wildlife Research Area, I felt that the decision to cull was a betrayal of "personal friends," and resisted the move strongly. It is worth discussing this culling operation, however, because it has a direct bearing on the adaptive management theme of this workshop, and shows how the situation as we perceive it is often fraught with errors.

In 1976, we thought the Sengwa elephant population numbered slightly over three hundred animals (this from ground transects and "total-count" air surveys). By 1978, from field work done in the course of my Ph.D.

thesis (which I am still writing up), I began to suspect that there were far more elephant. I photographed one assemblage of 462 animals on occasion, and saw at least another 100 in the area on the same day. In 1980, the decision was made to cull. The initial objective was to remove some 400 animals from Sengwa and the adjacent Chirisa Safari Area in an area straddling the boundary. A detailed research project was set up to remove one clan of elephant, and radio-collars were placed in a number of herds in the culling area and in the surrounding areas. Each day during the operation the culling area was surveyed and the figures for remaining elephant plotted on a graph. After removing 400 elephant, the survey figures on the last day of the cull showed almost 400 animals left in the area. Wild debate broke out: some maintained that elephants were moving into the area as fast as we were shooting them, others that we were shooting animals from adjacent areas who were unlucky to have made temporary incursions into the culling area, and still others maintained that the original counts were way out. To settle the argument, we decided to reverse the question: instead of deciding how many animals were to come off, we decided how many were to remain. I then set about radio-tagging a number of herds in the research area which would be the survivors, and this was followed with another cull to remove all the untagged groups. A further 400 elephant were removed leaving a population of 300. That population is still tagged today and can be counted at will. But the upshot of it all is that from an area which in 1975 we felt held at most 300 elephant, we culled 800 and have left a population of 300. There is little doubt from the extensive radiotracking work that animals are not moving into the area rapidly. There is some truth in the statement that odd herds were killed who were not normally resident in the area, but the main point is that our counts were a long way from the true figure.

The most spectacular feature of the Sengwa cull is the vegetation recovery in the area. Had I not lived there for eight years prior to the cull, I would not have believed it. *Acacia tortilis* woodlands, which had all but disappeared during the years I was present, have come back within four years of the cull. One large open area known as the "cornfield," in which there were virtually no trees after about 1974, is now a dense woodland of saplings 4-5 meters high.

I would make one point about culling before leaving the subject. I don't think there is much point in doing it by halves. If the decision is to remove some elephants (or any other species), then remove enough of them so that you have a chance of detecting the before-and-after results of your action. Within the margins of ecologists' errors, it is pointless, say, to fiddle about with figures like 5% or even 10% of a population when you can't even count that population with an accuracy better than 25%. This point has been made emphatically by Barnes (1983) as a result of his detailed study of elephant-woodland interactions in Ruaha National Park, Tanzania. If you must cull, cull early and cull hard.

4. PROBLEM ANIMAL CONTROL:

When I said earlier that there was one form of wildlife utilization which really is contrary to the WCS--this is it. I fully accept that the odd troop of baboons and sounder of bushpigs has to be eliminated to protect crops. And I accept with inevitability that the range for wildlife

has to shrink in the face of human population increase and this must lead to a decline in numbers. But I deplore the waste of resources when there are better options for their disposal, or when a resource is being destroyed by a development which offers less in the long term than the resource which it is replacing. In some cases in Zimbabwe, problem animal control arises simply through bad land use planning, in others it is a failure institutionally to provide pioneering frontier communities with the structures to make wildlife husbandry a part of their life. In many cases, traditional communities who have lived cheek-by-jowl with wildlife all their lives, are exploiting a situation of gullibility on the part of new administrators in demanding to have animals shot to protect nonexistent crops. Not that I blame them in the slightest: because we have effectively dispossessed them of all rights regarding wildlife, this is an obvious strategy to achieve a nominal harvest of a resource which they feel is rightfully theirs.

The killing of animals to protect crops or human safety is one thing: far more serious an abuse of wildlife is occurring under the guise of clearing the country of the tsetse fly and foot-and-mouth disease.

a. Tsetse Fly Control:

At one time, wildlife eradication was part of the armory of veterinary measures to contain the fly front. Control was carried out by building extensive game fences at the limits of the infested area, and all wild animals outside the fence were shot. In more recent years, the success of aerial spraying of insecticides, coupled with ground spraying teams using DDT, has seen the eradication of the fly over vast areas. This year for the first time the Department of Trypanosomiasis Control is using traps which attract flies by scent and then sterilize or kill the flies. The technique looks like it's being successful and could well revolutionize tsetse eradication.

Despite all this, the tsetse department is still hunting in Zimbabwe and killing significant numbers of animals. They argue that this is to protect fences (which have absolutely no role in the battle against the fly these days: indeed, in some areas where they are hunting the fly front is so far away that there are actually complete game reserves between the hunters and the fly front). I believe that their sole reason is to ration labor gangs, or worse still, to retain staff in the field by providing hunting perks. The fact is, they are killing game which rightfully belongs to rural communities, and acting in a manner which is not acceptable at this stage of the country's development.

Far more insidious than the hunting operations carried out in the name of tsetse control is the long-term implication of eradication of the fly from all parts of Zimbabwe. There is evidence from elsewhere in the country that as soon as an area is fly-free, it is overrun with cattle and desertification is likely to follow. Obviously, this doesn't have to happen; with good cattle management, the eradication of the fly would add to the national productivity but, in practice, uncontrolled grazing rapidly reduces areas to wasteland. The tsetse department do not regard this as their responsibility. In a recent meeting, I was told categorically that their job was to eliminate the fly, and other people should worry about

what happens to the land afterwards. In vain, did I use Bell's (1983) argument about the role of scientists as concerned citizens.

b.   Foot-and-Mouth Disease Control:

Of tremendous topical interest in Zimbabwe at the moment is the eradication of buffalo over large areas of the country in the interests of FMD control. This is one of the saddest instances I have ever seen of a runaway veterinary department, far too powerful within the government structures, oblivious to the arguments presented to it by conservation agencies, land use planners, and the very farmers for whom the disease control is being carried out, moving against the current of public opinion.

At the outset, it is probably important to point out to you that the pathogenic effects of FMD in Zimbabwe are negligible. Cattle which contract the disease are out of sorts for a few days, but survive quite happily. This is not the case in the Western Hemisphere: FMD takes on a virulence which is the dread of every cattle farmer. What stock is not killed by the disease is killed by the authorities to prevent spreading of the outbreak.

Botswana has decimated its wildlife through veterinary fencing policies. Williamson (pers. comm.) states that the national wildebeest herd has been reduced from some 300,000 to 30,000 in less than four years as a result of fences spanning the entire country to control FMD outbreaks. These fences are affecting Zimbabwe's wildlife along the international boundary with the Hwange National Park. A year ago, in discussions with our own veterinary department, we all agreed we would not fall into the same trap. Instead of attempting to make the entire land surface area of Zimbabwe suitable for beef export to the European Economic Community, we would fence off the marginal peripheral areas of Zimbabwe with cordon-sanitaires and restrict beef export to the central plateau of rich pastures where the main beef production takes place. Cattle would be raised within the FMD-infected areas but such animals would not find their way to the export market.

Suddenly the lure of export markets under the Lome Convention became reality. A flurry of fence building took place to satisfy the European health inspectors, and the campaign against the buffalo outside the broad lines drawn by Cokey pen on the national map was on. There was no consultation with other government departments despite earlier promises.

In recent meetings with the Departments of Agriculture and Veterinary Services, we have pointed out that:

a.   The gross value of the wildlife industry was of the order of $106,000,000 annually, compared to a beef industry worth about $260,000,000--in other words, we are not just poor relatives without rights.

b.   The cattle industry lost $36,000,000 in the previous year, and despite the large amount of foreign currency that could be realized from beef export, it was not "free" money: the costs of servicing the cattle industry inside the country consumed most of

the profit. The wildlife industry, on the other hand, had minimal inputs for a very large return--of the order of 1:4.

c. Buffalo are a vital part of that industry. In the areas where the buffalo were being eradicated, the expected cattle production was negligible in the national economy, while the buffalo were contributing thousands of dollars (in foreign currency).

d. Buffalo are a pivotal point in the plains game safari industry. Their value is way out of proportion to their part in the hunting bag. A plains game safari, which includes a buffalo, sells at three times the price of one without. Those ranchers which have access to buffalo are realizing a yield of the order of $4 per hectare from their land, while those without are earning less than $1 per hectare.

e. In the recent drought in Zimbabwe, most of the extensive cattle ranches in the lowveld of the country verged on bankruptcy. Those who had devoted all or most of their production to game have survived two drought years with significant profits.

f. The proliferation of fences in the country has resulted in enormous quantities of wire being available for snares. In some areas, local residents are removing fences as fast as the veterinary department builds them and most of this wire is finding its way into protected wildlife areas in the form of poachers' snares.

g. To improve the value of beef production in one part of the country, we are actually lowering the productivity in another part by eliminating buffalo.

Perhaps we will win some battles in the coming months, particularly if some of the conservationist movements within the EEC realize that the Lome Convention is resulting in massive slaughter of wildlife. But, I don't feel very optimistic--the whole *raison d'etre* of veterinarians is the elimination of pestilences, and the idea of contaminated pools of disease around the country is anathema. Ultimately, they visualize a Zimbabwe free of wild animals except those heavily fenced in parks and a disease-free cattle industry.

5. SPORT HUNTING:

In Zimbabwe, sport hunting is an extensive industry, earning millions of dollars of foreign exchange and revenue for the central exchequer in license fees. To me, the most important feature of the safari industry is that it barely touches the resource base. Being familiar with limits of productivity that can be expected on poor soils in semiarid areas under any form of land use, I never cease to be amazed at the revenue that can be earned from hunting in such areas. It is the one industry that escapes the limits set by nature in sunlight, soil and water. Hunting quotas barely touch the wildlife populations since they are aimed almost entirely at the trophy market (typically the quota for bull elephant is less than 1/2 of a percent, and soft-skinned game is around 3% of population numbers).

Now it may seem to you that Zimbabwe is not acting in the spirit of conservation by promoting hunting. A documentary film producer from the BBC was horrified when he found that our department was actively promoting hunting. When I asked him if he enjoyed fishing, he said yes, but hunting was an entirely different matter. When I queried his moral gymnastics, he confessed that perhaps there was nothing wrong with hunting, but it was the awful people who took part in the sport. All hunters have gross sexual hangups, and we, as a government department, should "distance ourselves from them." Now it seems to me that lots of people who are not hunters also have sexual hangups and if we, as a government department are going to start exercising judgement on who should and shouldn't be encouraged in wildlife areas on this basis, we are in for a difficult time. In Ardrey's swansong, *The Hunting Hypothesis*, he makes it clear that man has reached the 20th century without his genes being able to adapt fast enough. There is still a great deal of the primitive in men and to deny it is to wear rose-colored spectacles.

I believe that the banning of hunting in many countries in Africa is counterproductive. Hunters are terribly jealous of their resources and put a great deal into antipoaching and other conservation measures. The revenue that is lost to a country by stopping hunting is not made up in any other way. You won't convert these "awful people" to game-viewing--they will simply go somewhere else.

An interesting situation exists in Zimbabwe regarding black rhino. We are in a position where we could immediately put black rhino onto hunting licenses because our populations are in a reasonably healthy state. But we don't because of the crisis in rhino conservation elsewhere in Africa. A single rhino license would realize a minimum of US $25,000, and that could do a lot for conservation in our country. Rhino have no value in the eyes of our rural dwellers because there is no legitimate monetary value attached to them--except for those locals who have for the first time in Zimbabwe this year entered the poaching racket for rhino horn. Last year we lost some 40 odd rhino in the drought and a number were poached. Perhaps, we will think again about putting rhino onto hunting licenses.

6. GAME RANCHING:

A large number of commercial farms in Zimbabwe have now turned to game ranching, either as their entire operation or in conjunction with cattle. The trend is increasing and has proved totally viable, particularly in the recent drought years. I have a recent paper with me by Brian Child which surveys some 30 game ranches in the country and shows their profitability.

Game ranching is largely the result of the 1975 Wildlife Act, which gives ownership of wildlife to the landowner. This was an important break from the "King's Game" syndrome introduced by the British (Graham 1973) in which the state owned all game. Our next big challenge is to extend the principle to the communal lands in Zimbabwe.

Game ranchers engage in the full gamut of wildlife activities including:

a.   Safari hunting, mainly for plains game, but which they may supplement with big game animals from state land. This is still the most profitable land use.

b.   Sustained yield cropping for venison and hides. There are surplus numbers of animals unsuitable for trophy hunting on game ranches and overpopulation is a frequent problem which can only be solved this way.

c.   Trading in live animals. This is an increasingly lucrative business. South Africa is prepared to pay very high sums for sable, tsessebe, buffalo and several other species, and there is a considerable internal trade amongst ranchers inside the country.

d.   Photographic and game-viewing facilities. There are numerous small game ranches on the outskirts of the major cities which cater for weekend trippers amongst their other operations.

One of Zimbabwe's successes in recent years has been the establishment of successful crocodile farms in many parts of the country. These farms operate on the principle that a limited number of eggs from the wild are supplied to them by the Department of National Parks and they are obliged to return a certain percentage of the progeny to the wild after rearing them past the most vulnerable stage. Most of the farms have now established their own breeding stock of crocodiles and no longer need the supply of eggs. It is particularly noticeable that crocodile populations in the wild have increased dramatically since the inception of this project. At the last CITES conference in Gaborone, Zimbabwe became the first country authorized to sell crocodile skins on the world market. This represents a breakthrough in the rules pertaining to Appendix I (Endangered Species).

7.   CONCLUSIONS:

Through diverse activities the wildlife industry in Zimbabwe has become a major foreign currency and internal revenue earner. Its inputs are minimal when compared to, say, the beef industry which is of a similar order of magnitude. The value of such a diverse industry lies in its relative invulnerability to the market forces of tourism. It is important that the industry is overseen by an agency which has the long-term interests of conservation at heart, but is sensible to the potential for private industry to assist in conservation in many aspects. Such an agency must continuously upgrade its goals (adaptive approach) in the light of new opportunities and demands from the public.

Perhaps the biggest challenge facing us at the moment is to bring the peasant economy sector into the wildlife industry. The methods of achieving this are not simple, and this is not the place to begin an in-depth discussion on the subject. Suffice it to say that approaches involving handouts from conservation agencies are not the correct approach, and active management by the participants seems to be the only way. It is important that the actions by overseas conservation lobbies do not prejudice the developing wildlife industries in rural areas: bans on

hunting and trading in wildlife products will do just that, and frustrate attempts to bring conservation in rural Africa to fruition.

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CHAPTER 16

PERSPECTIVES ON WILDLIFE CROPPING OR CULLING

BY

I.S.C. PARKER

1. INTRODUCTION:

In this paper wildlife *cropping and culling* are terms specifically applied to harvesting wild animals to provide continuous, sustainable supplies of animal products--meat, hides, trophies, etc. Such activities fall within the well-established principles of the agrarian science of animal production. This paper discusses the relationship of this science with the more amorphous field referred to commonly as "conservation."

Wildlife has been cropped successfully in all African countries. Nevertheless, as pointed out by Parker and Graham (1971), in recent times some of the most profitable projects have had confused rationales as have virtually all those which have failed. The purpose of this essay is to provide a broad background against which specific proposals can be considered.

2. ANIMAL PRODUCTION PRINCIPLES:

The science of animal production is geared to efficiency and economy. It seeks these attributes through gaining as great a degree of control as possible over animal natality, growth and mortality. One factor, overall, determines the degree of control we can exert. It is tameness. Maximum efficiency in managing any animal is attained when we can make them conform most closely to our requirements. Tameness, the absence of a flight reaction to human presence, the absence of avoiding behavior, are the keys to controlling conception, growth, disease control and timing mortality to best suit human requirements. This is glaringly self-evident, yet has been repeatedly overlooked. The principle applies whether the species are domesticants or nondomesticants. That extreme tameness can be attained with nondomesticants has been illustrated convincingly by Geist (1971) and Parker and Graham (1971), among many. When animals are unconcerned by the close approach of man or vehicle, as happens in many national parks, they can be slaughtered or captured with relative ease and low expense. That such activity need not dispel the tameness of survivors has been reported by, among others, Laws, *et al.* (1975). The salient point is that really wild, timid and frightened animals are unlikely to provide a useful base for efficient, economic exercises in animal production.

Accessibility is closely related to tameness. When animals are sufficiently tame they can be covered from rough, broken or wooded terrain that they might use for foraging, and directed to where man wants them. However, the less tame they are, the more imperative it becomes that they occupy ground over which man can move easily both to locate and use them. Thus, on open plains which allow speed to overcome flight reactions, even relatively wild animals can be secured. However, even on the most open ground there comes a point when the degree of wildness renders use uneconomic. Dense vegetation, steep slopes, rocky ground and any abundance of aardvark (*Orycteropus*) or spring hare (*Pedetes*) all combine to hamper economic usage.

Animal density is another important factor, individuals must be present in such abundance to permit given numbers to be secured within specific time limits for given efforts (including mileage, ammunition, etc.). These thresholds vary from species to species but for each a critical density exists below which cropping must be uneconomic.

Viable markets must exist for produce. Demand for meat is influenced by price, presentation, tradition, religion and alternative sources. Demand for exotica in the form of game hides and trophies has been under attack from conservationists in North America and Europe and has been severely eroded in the past decade. These points may be self-evident but have been often overlooked in the past.

Meat handling technology and principles are yet another area of critical importance to cropping and culling. The economic attraction to both these activities seems to have some connection to the old poachers' concept that undomesticated animals are unowned and free for the taking. Because of this, a fallacious idea has developed that game meat must be cheap. True, when the peasant hunter (poacher) harvests an animal in his own time to feed self and family, the costs involved are little more than the time that he has to spend hunting. However, if modern standards for hygiene are adhered to and modern technology applied, the production of game meat becomes expensive. By definition game lives in wildernesses where communications are usually poor, transport costly and hazards unpredictable. Securing them to some preordained plan calls for a high degree of organization for slaughter, processing, storage, distribution and marketing. By virtue of wild origins alone, game meat production is likely to be complicated and, therefore, not cheap.

Meat is not only perishable, but a vehicle in which harmful pathogens can be transferred from their original hosts to man and other animals. Methods for handling meat have evolved to inhibit decomposition and minimize disease risks. They should be clearly understood by anyone planning a modern meat production operation, for they have bearing on the appropriateness of technique for securing animals. They fall into two categories: antemortem and postmortem routines.

At their most advanced levels, antemortem routines start prior to an animal's conception when its parents are chosen to produce a disease-free carcass with desirable characteristics. Subsequent measures optimize growth and facilitates prophylactic and curative treatment for diseases. Such steps are clearly inapplicable to wild animals, where the only practical antemortem routine must be a cursory glance to detect any obvious disability or deformity.

Ideally animals should be kept calm and free of strenuous movement immediately prior to slaughter. Vigorous muscular action leads to raised meat acid levels and muscular dystrophy (Young 1975) which lower meat quality. Such requirements are also difficult to meet in the wild. Indeed, it is common for hunted animals to be considerably exercised immediately prior to slaughter as they try to escape their hunters.

Slaughter should take place in hygienic surroundings to minimize bacterial contamination. It should be humane and cause as little damage

to tissues as possible. Yet again, such needs are difficult to meet in the field.

Postmortem routines commence with severing major blood vessels--usually the carotid arteries--before the animal's heart ceases to beat. This permits the evacuation of most carcass blood, reducing the volume of free liquids in the carcass through which bacteria spread quickly, and improves keeping qualities. The alimentary tract is a large internal source of contamination which, ideally, should be removed from the carcass within a few minutes of slaughter without any ruptures or content spillage. Both carcass and viscera should be inspected to ensure freedom of pathogens that might be dangerous to man. Subsequent treatments, processing, distribution and sales call for continued cleanliness to provide a durable and safe product.

It is self-evident that such desiderata are difficult to attain outside a proper slaughter house, let alone with wild animals. Indeed, they impose such problems that many espousing game cropping in the past have sought exemption from them on the grounds that such standards are unnecessary. They point to the millions of animals, both domestic and wild, that are killed annually, worldwide, by farmers and sportsmen, without heed for official hygiene laws or disastrous consequences. Mann (1968) pointed out that adherence to high standards in meat production raised overheads to such levels that prices went above the level that could be afforded by most Africans. He questioned the sense of insisting upon a hyperclean product if it was inevitable destined for the usually unhygienic environment of the average low-income kitchen.

Both the game croppers seeking exemption from high standards and Mann (op. cit.) make valid points. However, both have missed the principle concerned. When a farmer or sportsman kills an animal and butchers it for his own consumption, or gives it to family and friends, the act is private and they consume the product at their own volition. What the individual does for himself, or for others *gratis*, is largely outside the realm of public responsibility. However, when meat is sold for commercial gain and the seller solicits the public to buy the product, quality becomes of direct public concern. On this ground, there is no reason why wild meats should be treated differently from those produced by domesticants.

Human conditions vary from place to place and standards applicable in one may not be valid in another. In any situation, the level of hygiene standards should be a public (medical) judgment in which human need for protein is balanced against the risk of inadequate quality control. There may be instances where nutritional need is so great as to outweigh the dangers of meeting it from uncontrolled sources. The pertinent principle is that any case for lowered standards should be decided on the basis of advantage to consumer, not producer. If it exists, it will apply equally to domestic livestock as well as to wild species. Ensuring meat hygiene has profound influences on wildlife cropping undertaken to provide food.

The most obvious requirement in managing any form of animal successfully is familiarity with it. This is an attribute possessed by stockmen, shepherds and habitual hunters. (The term habitual hunters should not be confused with professional hunters who cater for the tourist

trade in sport-hunting foreigners. Such men are more properly couriers and entertainers who, while they may hunt, usually rely on local hunters in the guise of trackers and gun-bearers to provide basic knowledge of wildlife.) It is not a quality imparted by any academic degree. In the recent past, there has been a widespread tendency to bypass the man familiar with animals but without formal education and substitute others formally qualified but unfamiliar with animals.

3. PAST WILDLIFE CROPPING & CULLING:

To give breadth to the perspectives presented in the preceding section it is worth reviewing some recent game cropping exercises. These fall into four classes: (a) traditional, (b) recreational, (c) elephants and hippo and (d) other ungulates.

a. Traditional:

While this form of game cropping has been, and probably still is, the most widespread form of wildlife use in Africa, stretching back millennia, it is also the most abused and ignored by conservationists in recent times. Generally, it is considered under the single heading of poaching. Yet, where measurements have been made of its role in rural communities, traditional hunting is a major source of food (e.g., Marks 1976). Techniques are numerous, vary according to quarry and region, but have yet to be documented into any continental compendium. If they have a common characteristic, it is that they are suited to the people who practice them. This may be a tautology, but in that the systems used have been devised and refined over a great span of time by the communities who benefit from them, they are likely to be very economical relative to the standards and desires of those who practice them.

Recording and understanding Africa's traditional hunting methods would be an important study in its own right. Attempting to detail any of it here, even at a regional level, is beyond the scope of this paper. Suffice it that the majority of practitioners and beneficiaries live within subsistence economies. They live off the land, have little money and tend to trade by barter when necessary. It goes almost without saying that such people do not have access to efficient meat storage facilities. Refrigeration and canning are outside their reach and their only means of storing meat is through drying or smoking: both of which are relatively inefficient and the product is vulnerable to insect pests (Parker 1972). In such situations greatest benefit from the product will be derived when the animal is taken according to the needs of the user. It is likely, therefore, that in subsistence conditions the most economic form of wildlife cropping is to permit continuation of what already happens: that is, leave it to the peasants.

b. Recreational:

Sport hunting was, until the colonial era, widespread in Africa. Again, as with traditional subsistence hunting, it has not been documented at a continental level. The records in the literature are thus sparse. Nevertheless, the royal hunting preserves established by Shaka Zulu, the King of Barotse and the Mwami of Rwanda before the arrival of white men,

have their parallels elsewhere in Europe. They reflect an elitist aspect of recreational hunting. However, in modern Botswana, many Batswana take out hunting licenses for sport as well as to hunt for the pot. In the colonial era, particularly in Anglophone Africa, sport hunting was largely monopolized by overseas visitors and colonists. This generated significant revenues and through this has continued into the post independence years. Thus, Botswana earns $2,000,000 annually from overseas hunters and Zimbabwe even more--$6,000,000 in license fees alone (R. Martin pers. comm.) However, in terms of animal production, sport hunting may provide the most lucrative land use in terms of revenue per animal taken and per unit of land area, but it leaves most of the "harvestable" crop untouched. Visitors from abroad are usually elderly and an inefficient means of taking the crop of animals theoretically available off many African game lands. Additional harvesting of the nontrophy animals (which will be the bulk of what is available) should not conflict with, but augment sport hunting.

c. Elephant & Hippo:

Game cropping in the modern sense began in East Africa in 1960 with the Galana Game Management Scheme (Parker 1964, Parker and Amin 1983) aimed to establish commercial game cropping and simultaneously give a legitimate livelihood for Watta (Waliangulo) hunters, the project rested upon cropping elephants. Their meat was dried and sold in Nairobi, as was their ivory and the thinnest portions of hide. It failed for a variety of reasons among which were:

(i) Though abundant ($0.78/km^2$), elephants were inaccessible in dense *Commiphora* woodland that reduced visibility to less than 50 meters and through which there were few roads.

(ii) Demand for elephant meat was poor. The local peasantry who ate it couldn't afford it even at cost. Urban people in nearby centers were prohibited from eating elephants by Islam and inland markets like Nairobi had sufficient domestic meats to satiate demand. The only outlet proved to be as dog food at less than cost price.

(iii) Sociologically the project was badly misconceived. The Watta are traditionally an elephant hunting people and their whole culture centered on the species. They were better able to teach the government officials how to live off elephants than the latter were able to teach them, as was attempted. This first endeavor to bring cropping into the context of modern land usage in East Africa made the classic mistake of accepting without question that the new and up-to-date technology must be better than the old in the form of well-tried tradition.

No hygiene rules were enforced in the Galana Scheme for the production of dried elephant meat. It is of note that had the project had no sociological goal and an involvement with the Watta, hunting elephants for ivory only would have been profitable.

In 1966, 1968 and 1969 elephants were successfully cropped in the Tsavo National Park (Kenya) and in the contiguous Mkomasi Game Reserve in Tanzania. These areas lie within the same ecological zone as the Galana Scheme. The main reason for both operations was to collect scientific data and thus, strictly, they should not be considered exercises in animal production. However, they are directly comparable to the Galana project in that the problems faced by the latter were overcome. Since the Galana Scheme ended it had been discovered that the whole of an elephant's hide could be used for high quality leather. Its price had risen to the point where its value exceeded that of the average elephant's ivory (Parker and Archer 1970). The critical problem of locating elephants had been solved through using an aircraft to both find them and then drive them to a predetermined slaughter site (Woodhead 1969). For political reasons and at government insistence, the meat from Tsavo and Mkomasi was dried and salted and, as from the Galana, was sold as dog food in Nairobi at a loss. In the western part of the Mkomasi Game Reserve it was found that the local Chagga people on Kilimanjaro wanted elephant meat. Traders were prepared to drive c. 190 km to the slaughter area, provide their own labor and transport to the butcher and carry the meat, then return and sell it around Mt. Kilimanjaro. To encourage maximum use, the meat was sold at the nominal price of Tsh 0.10 (<US $ 0.01) per pound. Government enforced no hygiene rules, but the sale of elephant meat met with considerable organized opposition from conventional butchers.

The Tsavo and Mkomasi elephant cropping was profitable because:

(i)   elephant were made accessible through the use of aircraft to both locate and drive them to predetermined slaughter sites;

(ii)   the price of elephant hide for fine leather greatly boosted the animals' trophy values which, in turn was sufficient to cover the unprofitable costs of handling the meat and use of aircraft; and

(iii) the personnel involved were very familiar with both the animal concerned and the routines called for.

The most intensive cropping in Eastern and Central Africa took place in Uganda during the 1960s. Aspects of this have been recorded by Ruheza (1968) and Bindernagel (1968). The greater part of this work took place in the country's two major national parks--the Murchison Falls and Queen Elizabeth National Parks. In these two systems c. 12,000 hippo and 2,000 elephants were culled. The circumstances were particularly favorable.

The teams undertaking the work were familiar with both species. The animals were tame and approachable. Both areas were open grassland giving easy access to both elephants and hippo. They were present in very high densities (Laws, *et al.* 1975). Though both areas were received relatively high rainfalls, wet weather did not offer more than a minor inconvenience. Markets for ivory and hide from both species were good, demand for their flesh was very high and no hygiene requirements were made by government.

The demand for game meat about the Uganda national parks rested on several factors that call for comment. Human populations were dense (333/km^2) within a 160 km radius of the cropping sites. The people were affluent, they lived in areas that were very well served with roads and, because of tsetse, there were few domestic animals from which to meet demand for meat. This was so high that even without ivory and the high-priced hides, the elephant and hippo cropping in the Uganda national parks would have been profitable. In such exceptional circumstances the ivory and hide were bonuses rather than primary supports as was the case with all other elephant cropping programs.

In Zimbabwe, South Africa and Namibia, elephant have been and are still being cropped in national parks as population control measures. In both situations the animals' trophy values are augmented by demand for meat at commercially viable prices. Techniques used are similar to those applied in East Africa and in both countries aircraft are essential to the work. Access to the animals is good and the technical competence of the staff involved is of a high order. Unlike the situation in East Africa, some meat hygiene rules are enforced. These are at a level far below that applicable to domestic stock in Zimbabwe, but in South Africa and Namibia they approach the rules applied in domestic slaughter houses. All three countries have excellent all-weather roads permitting distribution of produce with a minimum of impediment.

Between 1965 and 1972, large-scale elephant and hippo cropping was attempted in Zambia in the Luangwa Valley and its associated national parks and game reserves. Like the earlier Galana Scheme in Kenya, the Luangwa projects were failures. No clear rationale lay behind the decision to crop. At the outset the program was to provide cheap meat for the "protein deficient" local peasants. No evidence was ever presented to show that they were, in fact, deficient in protein. The project foundered when the local people showed little interest: they neither had the ability to buy the dried product nor the inclination to walk to and from distribution points (a matter of many kilometers). Later, Marks (1976) was to show that the people were nutritionally affluent in protein through their own hunting. In this respect, the Luangwa venture stands out as the classic illustration of failing to understand the constraints of rural subsistence economies.

When the Luangwa Valley program failed to achieve its original goal, a new target was devised. Its second aim was to show that wildlife could be managed to achieve conventional animal production goals: that is to produce a safe, hygienic supply of meat. This, too, failed. Later still, the program was claimed to have been an animal management measure with no commercial or animal production purpose (Parker 1972).

The Luangwa environment favored cropping over a six month season of dry weather. The area was well served with access tracks and roads, but they became impassable when wet in the rains. Animals in the parks were abundant and tame. Vegetation was open woodland and an aircraft was not necessary to either locate or drive them. On the face of it, the project should have been financially viable.

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When it became apparent that the people did not constitute a market in the Luangwa Valley, it was decided to sell fresh meat in the Zambian Copperbelt towns some 700 km away. This called for a high quality product subject to government-enforced hygiene rules. These and the distance that fresh meat would have to be transported, called for freezing facilities and the related capital outlay. The equipment installed was capable of freezing c. 360 tons per six month cropping season. Shortly after it was installed, an economist pointed out that to break even, the minimum capacity should have been c. 560 tons per six month season and that as it stood with its lesser capacity, the facility was not commercially viable. This observation was ignored. The program went ahead and frozen hippo and elephant meat was trucked tc the Copperbelt.

No market research had preceded the introduction of frozen elephant and hippo meat into the Copperbelt towns. Nevertheless, it came as something of a surprise when the humans, for whom it was intended, declined to buy it. In the end, it could only be marketed as a very high subsidized dog food.

The familiarity of the cropping personnel with elephants and hippos was, in Luangwa, of a lower order than in any other East, Central or southern African operation. Their ability to take whole herds of elephants, as was required, was poor. In the end, the Luangwa program closed after taking 1,464 elephants, 1,353 hippos and 237 buffaloes. Its failures came about through inept planning and bad administration. Having made an initial mistake over local meat demand, much more careful investigation of the alternatives should have been made. Instead, the mistake was repeated on a grander scale. By the time that it was realized that there was no demand in the distant towns, the investments already made in plant and equipment prohibited any profits being made. It is of particular note that none of the planners or staff concerned had the requisite professional experience to embark on a major meat handling and processing venture.

d.   **Other Ungulates:**

Cropping smaller animals than elephants and hippo has been tried on commercial scales widely in East, Central and southern Africa. As with the pachyderms, this has revealed a range of successes and failures. Some of them are considered here.

The Tanzanian Game Division attempted several small scale cropping projects in the 1960s. None are well-documented in the literature. Perhaps, the best known concerned harvesting zebra and topi around Lake Rukwa in the south of the country. No strict hygiene rules were demanded by the health authorities, but the Game Division officers tried to follow domestic stock procedures in as far as they could. The carcasses were sold to the local people at Tsh 20.00 (US $1.40) (E. Balson, pers. comm.) It was accepted that there was no profit in this, the idea being solely to dispose of a waste product and engender some local goodwill at the same time. The financial goal was to make a profit on the sale of hides in Nairobi, in neighboring Kenya. It was claimed that the operation showed a profit. However, the accounting did not take note of the Game Division's expenses in conducting the project (i.e., staff wages, salaries, vehicle

depreciation, vehicle running costs, firearms and ammunition costs, etc.) and the profitability is in doubt.

The most ambitious scheme for game cropping in East Africa was implemented in Tanzania's Loliondo District in 1968. Its primary aim was to harvest the district's large wild herbivore populations on a sustained basis. The team involved, Wildlife Services Ltd., was the same that had achieved the considerable successes with elephants and hippos in Kenya, Uganda and Tanzania. The project ran for little over one year before being abandoned through multiple difficulties, most of which were political.

The underlying problem was running a Tanzanian operation through a Kenya-based company. While the arrangement was made between the company and the Tanzanian Government, the latter's support was, at its best, luke warm. This international problem was compounded by an internal political issue. Loliondo is part of the Serengeti ecosystem. While there are populations of ungulates that are resident, for the most part, within the district, they do at times move into the contiguous Serengeti National Park. Vice versa, animals that use the Serengeti also make substantial use of Loliondo. The Tanzanian National Park Authorities objected to "their" animals being cropped when outside the park borders. They, therefore, tried to obstruct the Loliondo cropping at every possible opportunity. The closest market for game meat lay on the opposite side of the Serengeti National Park from Loliondo and the park authorities forbade the transport of meat across "their" territory. Meat had, therefore, to be sold 400 km away around the base of Kilimanjaro. The cropping company was called upon to try and differentiate between "Loliondo" animals and "national park" animals, leaving the latter alone. Local butchers about Kilimanjaro also joined the politics of the project as they objected to any competition to their domestic animal businesses.

Quite apart from the political entanglements, cropping in Loliondo proved difficult. In the dry weather, when Loliondo and Serengeti animals were mostly widely separated from one another, the former were distributed in the district's least accessible terrain. In wet weather when they came out of the district's northern hills and onto its southern plains, movement was difficult for all but light four-wheeled drive vehicles.

The Tanzanian veterinary authorities insisted on the program adhering to prescribed hygiene law for slaughter houses as closely as possible. Among many requirements these called for correct carcass bleeding (severing carotids while the heart still pumped), which, in turn, restricted target areas to brain and upper neck shots. This simple requirement raised the standard of marksmanship called for by a very substantial degree. Carcass inspection procedures had to be followed. Among the pathological conditions for which there were condemnations were cysticercosis, sarcosporidiosis, pleuritis, pericarditis, peritonitis, echinococcus, hepatitis, brucellosis, lymphal granuloma and anaemia. In certain parts of the district such pathological conditions led to condemnations in excess of 50% of a night's take. These results are in accord with the data of Sachs (1968) from the western Serengeti and Young (1974) findings from South Africa and emphatically obliterate the claim that wildlife is less prone to disease and harmful pathogens than domestic stock.

After Wildlife Services abandoned the Loliondo project, it was taken over by the Tanzanian Game Division. However, the original high aims were dropped and the project devolved into keeping a team of zebra croppers in the field. While the sale of hides was the main source of revenue, zebra meat was dried and sold around Arusha. However, all attempt to enforce hygiene law was abandoned. It is significant that the most successful game cropping team in East Africa, backed by adequate capital, failed on the edge of the region's most abundant wild ungulate populations.

At the same time as Wildlife Services were involved in Loliondo, the company was also carrying out a parallel but much smaller operation on a large government-owned ranch on the western slopes of Kilimanjaro. This project also failed, but for different reasons, while the ranch was well-served by tracks, the pastures were liberally strewn with lava boulders that made off-track driving very slow--and in many parts impossible. The animals were extremely wary having been subjected to decades of relatively intense sport hunting. They were, therefore, inaccessible and kill rates fell as low as one animal per 24 hours on occasion. While this venture was a financial failure, it produced a finding of consequence. The same meat inspection procedures adopted at Loliondo were followed, but not one carcass was condemned for parasites or disease. It established, as was to be expected on theoretical grounds, that these phenomena vary widely between areas.

A further parallel venture by the same organization at the same time concerned an endeavor to use game on a large wheat farm near Lake Basuto, west of Mt. Hanang, Tanzania. The animals--wildebeest, zebra and gazelle-- grazed nightly in the wheat. Government laid down a stipulation that all cropping was to be done within the wheat fields. The rationale was that at the same time as taking a game harvest, a measure of crop protection would be enforced. The animals, as expected, did come to associate disturbance with any approach while they were in the wheat and some protection was given to the standing crop. However, it also established the point with some economic pain, that it is uneconomic to try and crop animals success-fully on only a very small part of their range (i.e., the wheat fields), for they rapidly become inaccessible on that ground.

Tanzania's Loliondo program was rivalled in ambition by a joint FAO/Kenya government attempt to conduct extensive game cropping in Kajiado District contiguous to the capital--Nairobi. This commenced in 1972. The environment was open grassland and widely traversable with wheeled trans-port. Plains herbivores were abundant, particularly gazelle, wildebeest and zebra. They were relatively tame and approachable. Rain rendered the area impassable for about only two months of the year. Nairobi--the largest meat market in East Africa--was on the cropping area's doorstep and adequate capital was available to acquire whatever equipment was necessary. A large, mobile abattoir was built as were mobile chilling facilities. The only technical inhibitions to the program's chances of success were the fairly strict hygiene rules that had to be obeyed. Despite the generally favorable circumstances, the project failed.

As with the Luangwa Valley cropping (both were sponsored in part and organized by FAO), the team which both planned the program and carried it out was severely deficient in familiarity with the field of animal

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production. None of the staff had handled carcasses commercially, none had traded in animal products, none had actually managed any wildlife in Africa before. Field competence was low as illustrated, for example, by the poor marksmanship that led to the loss of 31.4% of wildebeest meat through bruising (comparable losses from Wildlife Services Ltd. were 3.1% with zebra in Loliondo, 0.8% for impala in Kenya and 2.7% with Thompson's gazelle in Kenya (Woodford, *et al.* 1976)). Whereas Wildlife Services Ltd. operated at night (i) because low ambient temperatures and lack of flies improved meat hygiene and (ii) animals were more easily approachable with a light at night, the FAO Kajiado project only worked during daylight hours. The main reason appeared to be that staff considered working after dark to be an unnecessary hardship. Such an approach could not have been adopted by a commercial concern dependent on profit for survival. The sole quali- fication that the project planners and officers were able to offer was that they had wide experience of sport hunting and were wildlife scientists. It starkly illustrated the failure to distinguish between the field of animal production and that of conservation. Mainly for this reason the project failed.

The Kajiado Project did, however, expand knowledge widely in the veterinary aspects of cropping (Woodford, *et al.* 1976, for example) and it also established the inappropriateness of herding and corralling wild animals prior to slaughter. In an endeavor to facilitate slaughter and to remove the problems experienced with shooting, the Kajiado project rounded up and drove herds of wildebeest and zebra into pens using a helicopter. The captured animals so bruised one another once closely penned that, given the meat standards demanded, their carcasses were unacceptable. The technique of driving and penning has value where the objective is capturing wild animals for transfer elsewhere, or handling, but is inappropriate as an immediate antemortem strategy. The case of bruising any living animal tissue, human or otherwise, that is such a striking feature of forensic pathology, is easily overlooked in meat production situations until the carcass is examined (cf., Simpson 1975).

The Kajiado project's failure was thrown into relief by the success of a parallel program conducted on two Kenya ranches at the same time (Parker and Graham 1975, Blankenship, Parker and Qvortrup, in press). Tameness, accessibility, animal densities and the croppers' familiarity with all aspects of animal production were of a high standard. Nairobi was the main meat market 120 and 200 km away from the ranches, respectively. However, the program was subject to strict hygiene rules whose stringency is apparent from the following list:

a. All carcasses had to be bled through severing the carotids while the heart still bled or the carcass was condemned.

b. If killed by shooting, only brain or upper neck shots were permissible. Any bullet elsewhere in the body brought automatic condemnation.

c. Evisceration had to take place within 60 minutes of slaughter in hygienic surroundings.

d. Carcass bone temperatures had to fall to below 13°C within four hours of slaughter and below 3°C within 16 hours; the fall in temperature to be continuous with no temporary gains.

e. Evisceration and processing of carcasses to be in dust-free and fly-free areas.

f. Personnel handling carcasses to be bathed and dressed in clean white uniforms and all to be medically inspected and certified free of unhealed sores or disease.

g. Facilities for sterilizing tools and washing hands to be continuously available.

h. A minimum supply of 33 litres sterilized (chlorinated) water per carcass to be available.

i. Carcass and viscera to be inspected by a qualified government meat inspector immediately following evisceration.

j. Carcasses passed fit for human consumption to be transported in dust-proof, insulated vehicles.

These rigorous requirements were met and the project was commercially successful. Cropping was carried out at rates of up to 140 carcasses a night--the limit the equipment could handle. Had this limit been raised the actual hunting could have coped with up to 500 a night. The achievement called for a high order of competence and the ranch owners had to contract the work out to a firm of specialists. The owners would have made greater monetary profits, however, if they had abandoned all thought of meat production and merely taken hides from animals they themselves shot at their own convenience.

A final East African example concerns that Yaida Chini plans to establish large-scale cropping in Tanzania's Yaida Valley. The idea, similar to the philosophy underlying the Galana Scheme's, was to integrate the nomadic, Hadza hunters and gatherers into Tanzania's monetary economy, as well as to develop game-cropping techniques. It never got beyond some simple cropping trials. It repeated the Galana mistake. By inclination and culture the Hadza were, like the Watta, hunters of outstanding competence. If any people were in a position to teach others how to live off wildlife, it was these two tribes. It was arrogance, no matter how well-meant, to suppose that nonhunters could teach them to do better.

With the wisdom of hindsight, the most obvious course for integrating the activities of these hunting people into cash economies would have been helping them to market produce. An extension service that improved the treatment of trophy material, improved the storage of meat products and made sure that they received the best prices for their produce, would have achieved this. That this can be done has been very clearly demonstrated in Botswana. Botswana Game Industries (Pty) Ltd. is the largest concern in Africa in dealing in wildlife produce. It started in the mid-1960s using raw material provided by Bushmen and Batswana traditional hunters. The quality of hides and skins produced was very poor at the outset. However,

by creating an advisory service that told hunters how best to preserve their trophies together with a fiscal policy of rejecting poor material and paying high prices for that which was well-prepared, the quality of product rose dramatically. Whereas over 50% of hides and skins offered in the mid-1960s were rejected, by the mid-1970s this had fallen to under 5%. Today, some 5,000 traditional hunters sell their produce to the company. The approach achieved a marked success where the Galana and Yaida Chini ventures failed.

Dasmann and Mossman (1961) generated widespread interest in game cropping in Zimbabwe. However, this waned in the 1960s and there was a progressive tendency to change goals from meat production to sport hunting (Johnstone 1972). This is now the main form of wildlife use in Zimbabwe (Chapter 17). In many instances wildlife populations did not provide the off-takes expected to sustain the originally hoped for meat production.

In South Africa game cropping of several antelope species has shown considerable growth on private, well-developed land over the past two decades. Recently, this has been linked to the emergence of a lucrative European demand for venison. In 1979, this took c. 60,000 antelope carcasses. However, it is worth recalling the point made in my paper on the interaction between man and wildlife earlier in this symposium, that the animals used on the South African ranches are no longer truly wild. They are controlled to a substantial degree and are more in a crude form of domestication than they are uncontrolled or uncontrollable.

The accumulation of experience illustrates that game cropping in Africa can be profitable, but that the outcomes are subject to a wide range of influences. Outside the realm of peasant/traditional involvement, organized endeavors have been as marked by their failures as by their successes. Of particular importance in the programs that have achieved their objectives has been human competence and experience and a high level of familiarity with both animals and animal production techniques. The number of people with these qualities is very limited indeed. Of equal note is that the successes have not been in wildernesses, but on well developed land, be it national park or private ranch.

Overall, the evidence is that wildlife cropping is not a simple, easy way to get meat either or profits--other than at a strictly peasant self-hunt self-help level.

4. GAME PRODUCTIVITY:

Domestic livestock can sustain annual off-takes in excess of 20% of its numbers. Similar productivity is possible from some wild ungulates (e.g., mule deer--Swank 1958) and it was knowledge of this sort in North America which gave rise to hopes that similar off-takes might be possible from African herbivores. The response of impala to extermination shooting in Zululand and Thomson's gazelle to heavy culling on ranches in Kenya, demonstrated high productivity that supported them. More recently, the response of springbok and impala to cropping and population manipulation (adjusted sex ratios, etc.) has confirmed an innate high productivity. However, many of the early assumptions made by wildlife biologists in Africa ignored a fundamental aspect of population dynamics.

The missing appreciation, which was well-documented (e.g., Ricker 1958), may be synthesized thus. Population growth is usually sigmoid or curvilinear, with the fastest rates occurring about the midpoint between zero and the number determined by a range's carrying capacity for the species concerned. As a population increases beyond this optimal midpoint its growth rate declines until at carrying capacity it is zero. At this point natality is balanced by mortality.

The science (or art?) of animal production in the modern cash economy sense is concerned with exploiting a population's rate of increase. To achieve the greatest yield of carcass weight within a given time, a population must be held at that point where its rate of growth is greatest. That is, that it must be held well below range carrying capacity. Wrongly, this point of highest carcass yield per unit of time is also referred to by many ranchers and range management specialists (usually citizens of the U.S.!) as carrying capacity, whereas it should be called the point of optimum economic yield. At this optimum population growth point many species may be able to at least match if not exceed a 20% off-take in numbers annually. Temperate zone cattle and deer populations are held at or around this optimum. There is no reason why African ungulates should not be similarly managed. However, it would call for their populations to be reduced from carrying capacity to the more productive lower population level.

The biologists observing herds of African ungulates failed to appreciate that they were probably at carrying capacity and were mistaken to assume that at those population levels they could sustain high off-takes or exhibit the productivity and replacement capacities of populations half their size. This, perhaps, was the reason why the game populations on Zimbabwe ranches failed to live up to Dassmann's and Mossman's expectations.

There are considerable problems associated with trying to manipulate wild ungulate populations to conform to optimum economic yield requirements. These have to do with the complexity of African ecosystems and in particular with the very high number of competitive plants and animals in them. With domestic stock on a farm, or in the simple ecosystems of the temperate deer forests or South African game ranches, it is possible to hold populations of single or two/three species to predetermined productivity levels. By holding them below carrying capacity, abundant forage is ensured to fuel population increase. There are few or no competitors to pirate the feed reserves. This would be difficult, for example, on the plains ecosystems of eastern Africa. In them, the reduction of one species (or several) to the optimum productivity level might simply create opportunity for other types to use the forage that becomes available. Thus, attempts to reduce domestic stock to productive levels may be foiled by a subsequent increase in game species taking up the forage reserve that becomes available. Similarly, a reduction in wild ungulates might increase the opportunities for domesticants (it would appear to be so as ranchers go to some expense to be rid of most wild grazers where possible). The same might apply between the different wild species and there is evidence to this effect involving hartebeest and wildebeest in the Nairobi National Park (Ecosystems 1983). Even more confusing is the prospect of plants taking up the "slack."

The salient point is that, from a theoretical level, it would seem that any attempt to manage a species at its most productive population size will be confounded unless its potential competitors are likewise managed. In theory, and upon the demonstrated incapacity we have for managing more than one or two species at a time, harnessing the productivity of African wildlife complexes will inevitably be a complicated undertaking.

The purpose of this section is to stress, yet again, that while there are no grounds for not investigating the field of African wildlife cropping and utilization in more depth, equally there are no grounds for assuming that it will ever be the panacea offered by Dassman and Mossman (op. cit.)

5. **DISTURBANCE:**

Cropping large numbers of wild animals carries the prospect of widespread disturbance. A shot fired at a solitary animal disturbs it, terminally or otherwise, but no other members of its population. The same shot fired at and killing one member of a herd of 50 animals disturbs 49 others and, if at one in a herd of 1,000 disturbs 999. Thus, a single incident that is of little consequence to the population of a solitary species, rises in influence with increased gregariousness and can be of significance to communal species. It is an obvious but commonly overlooked fact that gregariousness raises the vulnerability of species to hunting disturbances.   The most harmful disturbances are those which are unpredictable. Hunters, to be successful, have to be unpredictable. Geist (1971) summarized the effects:

> "... disturbance is likely to be most detrimental if it
> is frequent and unpredictable, so that the animal
> cannot escape it.   In experimental animals, this
> unpredictability causes neurosis, loss of weight, loss
> of appetite, malfunctioning horn growth, susceptibility
> to predation, reduced reproduction or death."

Most mammals, which have been the traditional quarries of temperate zone sport hunters and which have provided the evidence of high game off-takes over extended time, are either solitary or small group species. The most spectacular case of a mammal that wasn't was the American bison, which was hypergregarious. A single shot was sufficient to make thousands run. The large kills made annually by white buffalo hunters must have caused huge disturbances which, with what we now know about its effects, must have been among the prime causes for the rapid population collapse. Similarly, trying to take 20% of the Serengeti wildebeest (i.e., 280,000 out of 1,400,000) which move in herds of many thousands, would result in disturbance of an enormous order and probable steep population decline.

Some species--e.g., elephants, rhinos, impala and buffalo--try to counter disturbance by retreating into thick vegetation and difficult terrain. Such strategies are, however, impossible in open plains country, Thus, the species that frequent them in large numbers--the megaherd species --may be particularly vulnerable to large-scale cropping disturbance. The possibility that this might bring about population collapse is sufficiently real to render it an area to be approached with great caution.

6. CONCLUSIONS IN SUMMARY FORM:

Peasant hunting is the most simple form of game cropping and the use that may confer the greatest benefits upon society.

Using wildlife in the modern sense of animal production has been undertaken successfully and profitability, but there have been many instances of spectacular failure. Nowhere has it been a simple or cheap way to produce meat. The outcome is subject to a wide range of influences in which skill on the part of the croppers is uppermost. Success has most frequently occurred on developed land and not in the wildernesses. The attached table of subjective values gives some insight into the variety of factors which have influenced some past East and Central African projects.

The management of complex, multispecied ecosystems has yet to be achieved and must be if large-scale game cropping is to ever become anything more than a subsidiary land use. Tameness has had so marked an influence upon successes that any refinement of technique will inevitably call for this quality to be enhanced. Efficient animal production's need for tameness is such that any wild species involved is almost automatically headed for the formal state of domestication. Tameness and the management of ecosystems ultimately called for by efficient animal production negate the concept of wild. That wildlife utilization in the form of cropping and culling has been largely propounded by conservationists implies the existence of a philosophical weakness in their cause.

Project	Species	Purpose	Success/ Failure	Familiarity Competence	Hygiene	Meat Demand	Developed	Market Affluence	Trophy Value	Access- ibility	Animal Density
Galana Scheme	E	C	F	++	+++	---	---	++	+++	---	++
Tsavo East	E	R	S	+++	+++	---	-	++	+++	+++	++
Mkomasi East	E	R	S	+++	+++	---	---	++	+++	+++	++
Mkomasi West	E	R	S	+++	+++	++	--	+++	+++	+++	++
Uganda MFNP	E & H	Rd	S	+++	+++	+++	+++	+++	+++	+++	+++
Luangwa Valley	E & H	?	F	--	--	---	++	--	+++	++	+++
Zimbabwe	E	Rd	S	+++	++	+++	+++	++	+++	+++	++
Kruger RSA	E	Rd	S	+++	---	+++	+++	+++	+++	+++	++
Loliondo	U	C	F	+++	---	--	---	-	+	-	+++
W. Kilimanjaro	U	C	F	+++	---	++	+++	++	+	--	+
Basuto	U	C	F	+++	---	-	+++	+	+	--	--
Kajiado Kenya	U	C	F	---	---	++	+	++	++	+++	+++
Ranches Kenya	U	C	S	+++	---	++	+++	++	+	+++	+++
Malawi Nyala	U	Rd	S	++	-	+++	+++	++	-	++	+++

Legend: E = Elephant, H = Hippo, U = Ungulates, C = Commercial, R = Research, Rd = Reduction, F = Failure, S = Success.

+ = favorable, ++ = good conditions, +++ = very favorable

- = unfavorable, -- = severe disadvantage, --- = very unfavorable.

With hygiene +++ = no requirements were made by Government while --- means very high standards were demanded.

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CHAPTER 17

CULLING OF NYALA ANTELOPES
IN LENGWE NATIONAL PARK, MALAWI

BY

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1. INTRODUCTION:

The increase in population of nyala antelopes (*Tragelaphus angasi*) in Lengwe National Park, Malawi and the associated loss of condition due to inadequate food resources and degradation of the habitat in general is an issue of great concern with regard to management of the park. The population of nyala antelopes is believed to have been less than 100 in the early 1960s, but by 1980 the population is assumed to have been 3,318 on the basis of annual counts by the National Fauna Preservation Society of Malawi (NFPS) (Bell 1981). The 1981 and 1982 population estimates are 3,800 (Bell 1981) and 4,340 (Bell and Banda 1983) respectively. Preliminary analysis of data for the 1983 nyala count data reveals a population of 3,515 (Bell and Banda in prep.)

The large number of animals is in itself not a matter of concern but rather the impact that the large population has on the habitat. In Lengwe National Park the population of nyala has a negative impact in that many areas are degraded. Bare ground is common especially in the vicinity of water holes. Opening up of the thicket communities is attributed to the increase in nyala numbers (Hall-Martin 1981). In addition, condition of the animals is very poor during the late dry season due to lack of sufficient forage. As a result, it is seen as a necessity that the population of nyala be decreased to a level where its negative impact is minimal, and to achieve this, culling operations have been recommended by the Department of National Parks and Wildlife.

The first cull was carried out in 1981, during which 419 nyala antelopes were removed (Kamvazina 1981). Even with this reduction the population in 1982 was estimated at 4,340 (Bell and Banda 1983), i.e., the population in 1982 was higher than the preculling population of 1981 (3,800). What this observation means is that the removal of 419 nyala antelopes did not achieve the desired goal of reducing the population. Whether due to the reduction or to higher rainfall, there were more resources per individual in 1982 leading to a higher reproductive rate. What stands out is that the population continued to increase. Bell and Banda (1983) recommended that reductions of 1,000 animals per year should be carried out for three successive years starting in 1983 in order to reduce the population sufficiently to give the vegetation a chance to recover. In pursuance of these recommendations, a culling operation was approved in June, 1983 to remove 1,000 nyala. The culling operation during which 840 nyala were killed took place from 19th June, 1983 to 26th October, 1983.

In this report, we report on the culling operation in general, describing the methods and equipment used, personnel, problems faced both organizational and technical, economic and public relations aspects of this exercise, the effects of the operation on the behavior and distribution of animals, and give recommendations as to how exercises of this nature should be carried out in the future.

2. THE OPERATION IN GENERAL:

While the primary purpose of the culling operation was to reduce the number of nyala antelopes, economics dictated that the operation be

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utilized as a revenue generator. Another associated purpose was to improve the public's attitude towards conservation areas by showing them that the areas set aside as national parks or game reserves have values which can benefit them directly. Researchers from different fields also took the culling operation as an opportunity to collect scientific data. We will discuss how these objectives were met separately.

a.   Reduction of Numbers:

The key factor was to reduce the population by the required number. The plan was to shoot the animals using a .270 caliber rifle, but due to lack of ammunition a .300 caliber rifle was used to shoot most of the animals. In addition, some animals were killed using .303, .270 and .220 caliber rifles.

Shooting was done from the back of a Land Rover pickup. The marksman sat on a bench at the back of the Land Rover. Seated on top of the Land Rover was a sack filled with wood shavings which acted as a pillow on which the marksman rested his gun when shooting. The marksman was flanked by two spotlight men, one on each side.

Shooting was done at night. The Land Rover was driven on tourist or management roads in the park, at a speed of between 20 km/hr and 30 km/hr. While driving, the spotlight men continuously scanned the areas on either side of the road. When an animal or group of animals was spotted, one of the spotlight men signaled the driver to turn in the direction of the animal(s) by moving the spotlight up and down in the direction of the animal(s). Once the group was identified as nyala, tracking was continued until the group was within shooting range at which point the marksman would signal the driver to stop. The marksman would then shoot as many nyala antelopes as he could from the group, signaling the driver to move on and in a particular direction as the situation demanded.

Shooting was nonselective, i.e., animals of either sex, young or old were shot. From a total sample of 380 nyala antelopes shot on 17 days during which animals shot were separated into three groups--adult male, adult female, and juveniles; a ratio of 42 adult females to 41 adult males to 17 juveniles was found. Taking the results of the sample and applying them to the total number of nyala antelopes killed we can extrapolate that 353 adult females, 344 adult males, and 143 juveniles were killed during the culling operation. In this report, juvenile includes females less than half the size of an adult female and males with horns less than 30 mm long.

Identification of nyala antelopes during the night was not always easy. Among the species confused with nyala were: adult female kudus if standing in tall grass or in a thicket were mistaken for adult male nyalas, Livingstone's sunis if sitting on an anthill, were mistaken for female nyalas, bushbucks in thickets were mistaken for female nyalas, impala standing in tall grass were mistaken for female nyalas. With experience, it became much easier to distinguish the species. Posture and behavior were useful. When nyala antelopes were spotted they normally did not raise their heads; if they did it was only for a short time; otherwise they put their heads down to hide from the blaze and they were restless, i.e., they continuously moved usually towards shadows. Head or neck shots are

required to ensure high quality skins and carcasses; this in turn requires rapid action by the marksman to take advantage of the few seconds in which the animal's head is raised. The other species confused with nyala on the other hand normally kept their heads high and stayed almost motionless until the vehicle approached very close. However, there were a few occasions when distinguishing of the species proved impossible. Four bushbucks and one impala were mistakenly shot during the course of the operation.

Out of the 840 animals killed, 24 were shot using .303 ammunition, 35 using .220 ammunition and 10 using .270 ammunition. The balance, i.e., 771 nyalas were shot using .300 ammunition. The total number of rounds of .300 ammunition used to kill 771 nyalas was 797 making an average of 1.03 rounds per animal. This figure is lower than that of 1981, i.e., 1.05 rounds per nyala (Jamusana 1981). The high ratio of rounds to animals is due to the fact that at times two or more rounds were needed to kill one animal, especially towards the end of the exercise when the animals were becoming wary. In addition to an increase in rounds being used per animal, there were misses, woundings, and ammunition used in setting the telescope.

The difficulty in obtaining the animals varied depending in relation to several factors. At the beginning of the exercise the animals were readily available since they had not been exposed to shooting for quite some time. As more and more shooting was done the animals became more wary and tended to run soon after seeing the spotlights, so that hunting difficulty increased, as did the ranges over which shots were taken.

Other factors that affected the exercise were changes in weather and the lunar cycle. When it was very cold the animals went into hiding deep in the thickets and, therefore, were unavailable. The team would drive for hours without encountering a single group of animals. Windy weather was another factor. When it was windy the animals were on the run even before they came within range. Moonlight spelt disaster for the operation. It was impossible to blind the animals sufficiently, with the result that they kept on moving, making them impossible targets.

b.   Generation of Revenue:

Killing of the animals achieved the objective of reducing nyala numbers; however the animals could not be left lying where they fell for economic and aesthetic reasons. We needed to utilize the carcasses to raise some revenue which would offset some of the costs incurred. To meet this objective, meat, horns and skins were sold.

Boarding the same vehicle with the marksman and spotlight men were four loaders and a Moslem. Once an animal was shot by the marksman, the loaders and the Moslem ran to the spot where the animal was lying. The loaders restrained the animal while the Moslem cut the throat for religious purposes, i.e., so that people of the Islamic faith should also benefit from the culling exercise by buying meat. Where several animals were shot in a group the Moslem and the loaders did not disembark until the last animal was shot at which time the marksman gave an okay to the loaders and Moslem to do their job. Once the animal had its throat cut by the Moslem, it was loaded on the Land Rover. Up to twenty carcasses could be loaded on

the Land Rover depending on the sizes of the animals shot. If many males were shot, the number loaded per trip was smaller, but when more females and juveniles were shot, the number was bigger. When the Land Rover was fully loaded, the team drove to the mechanical workshop at Lengwe camp to offload the carcasses. The mechanical workshop acted as an abattoir during this exercise.

At the workshop (abattoir), the animals were dressed after the research team had taken the necessary measurements. The dressed carcasses were hanged head down on hangers and washed clean. All these activities were done during the night. In the morning, the meat was inspected by an officer from the Department of Veterinary Services. The Veterinary Officer was particularly interested in checking for evidence of foot and mouth disease in addition to the general quality of the meat. After inspection the meat was ready for sale. The meat was offered for sale at K0.60 per kilogram (approximately US $0.810 per kilo).

Preparation of the skins involved removal of as much remaining meat as possible from the skin using scraping knives. The skins were then either laid down and salted liberally or put in a brine solution (salt water) for at least 24 hours or put in cattle dip (Tixol) for at least 24 hours. Skins that were laid down and salted were left lying until they were dry. Those dipped in cattle dip or brine water were stretched in a drying shed for drying. Within the drying shed, there were frames in which the skins were stretched. Two skins were stretched in one frame with the hair side between them. Once the skins were dry they were removed from the respective drying places and packed in another shed. In the storage place beetles were a problem, damaging the skin. Tixol (cattle dip) was sprayed periodically to keep off the beetles with limited success. Other insect sprays were also tried with varying success. The dry skins were offered for sale at the following prices: adult male skins at K10.00 each, adult female skins at K8.00 each, and juvenile skins at K5.00 each (US $7, 5.5 x 3.3 respectively).

Horns from the male nyala antelopes (females do not have horns) were prepared by removing the skin and as much flesh from the skull as possible using knives. Thereafter, the skulls were boiled and the remaining flesh removed. Normally the skulls were boiled after removing the lower jaw except if it was desired to have a complete skull. Lower jaws were collected by the research team for aging purposes. The skulls (minus lower jaw but with horns) were offered for sale at K15.00 (US $10.0) each. Some skulls were mounted on wooden shields and offered for sale at K25.00 (US $17.0) each. Note that the skulls offered for sale were those of adult males since the horns have trophy value. Most female skulls were discarded except a few that were prepared for the Ministry of Education and Culture as teaching aids in secondary schools.

c.   **Changing Attitudes of the Local People:**

The attitude of most subsistence farmers in the immediate vicinity of national parks and game reserves towards these conservation areas is that resources are being wasted. They would rather have the areas opened up for consumptive use, i.e., hunting, tree cutting, timber sawing, cultivation, etc. This attitude is evidenced by the many encroachment problems

encountered. The culling operation gave an opportunity to the Department of National Parks and Wildlife to show to the people that conservation can benefit the people directly through cropping of overabundant species and providing a cheap source of protein. To meet this objective the price of nyala meat was set below that of goat meat not to mention beef and pork. This low price was designed to give a chance to the local people, i.e., subsistence farmers around the park, to have some cheap meat. How far this objective was achieved will be discussed in the public relations section below.

d. Data Collection:

Culling exercises give a rare chance to researchers to obtain data that could be obtained with difficulty or not at all from live animals. Data on bled weight, heart girth, kidney fat index, food items identified from stomach contents, etc., can be obtained from the dead animals. Data like the ones outlined are important in understanding the biology of the species, and, hence, lead to its proper management. These data would be very important to the Department of National Parks and Wildlife. However, the chance was not fully utilized during the 1983 operation due to shortage of staff. The problem will be discussed further in the section dealing with problems and recommendations.

The Department of Veterinary Services is interested in studying parasitism in wild ungulates with particular reference to diseases that affect domestic stock. Again, the culling exercise offered a very good chance; however, in the 1983 operation, the chance was not fully utilized. Blood samples were collected only once by an officer from the Central Veterinary Laboratory in Lilongwe. The samples, upon examination, did not reveal any evidence of parasitism. A Professional Officer from the Department of Veterinary Services was to be attached to the operation full-time but due to communication problems he never appeared.

3. ORGANIZATION:

The culling exercise was divided into four sections: field team, skinning and skin preservation team, the meat sales team, and research team. The responsibilities of the different teams are described separately.

a. Field Team:

The field team was responsible for killing the animals in the field and loading them on a Land Rover for transportation to the abattoir where the animals were skinned (dressed) by the skinning team. The field team consisted of ten or eleven people: one marksman, two spotlight men, one driver, one person assisting the driver in following direction signs, one Moslem and four loaders. When an officer from the Department of Veterinary Services was available, he was the 11th person on the team. The loaders were assisted by one of the spotlight men, the person assisting the driver and the driver. In effect, when loading the animals, a total of five to eight people were available. The field team normally operated from 6:00 p.m. to 6:00 a.m. depending on the time of moonlight and/or dawn or dark.

b.   Skinning and Skin Preservation Team:

The skinning team consisted of one supervisor (game ranger or head game scout), one assistant supervisor (Leader Scout), and a team of eight people (unskilled laborers and classified workers grade III) to do the skinning. This team worked from 7:00 or 8:00 p.m. to 7:00 or 8:00 a.m. depending on what time the field team left and what time the last carcasses were brought in. They did not leave until all the animals killed that night were dressed and the abattoir was clean.

The meat inspector was included in this team. He inspected the meat as soon as all the skinning was finished and everything was properly cleaned. After inspection the meat was ready for sale.

Group B of this team was responsible for skin preservation. There was a total of six people in this team. Two people worked with team A to remove meat and fat remaining on the hide after skinning. Four people were actually involved in the preservation of the skins. Salting, dipping in brine or cattle dip, and stretching of the skins in the drying shed. Team B mostly worked during the day.

c.   Meat Sales Team:

The meat sales team consisted of one person handling bookings for nyala meat, one person handling cash and on-the-spot selling of meat, one person reading the scale, and two people helping with weighing and cutting the meat. The meat inspector also worked with this team to issue permits for meat taken out of the Lower Shire Valley.

This team worked from 7:30 a.m. to 5:00 p.m., in busy days without breaking for lunch.

d.   Research Team:

The research team consisted of one person taking measurements, one person recording data and one assistant to help whenever required. This team did not do any substantial work due to administrative and technical problems that arose in the course of the operation.

One game ranger was sent on a training course in Zimbabwe during the course of the operation contributing to a shortage of staff. The Research Assistant was subsequently given supervisory duties at the abattoir in addition to collecting research data.

The other problem was general shortage of labor which made it technically difficult to carry out the research work. Animal weights demanded that the animals be hanged and then put down and after evisceration hanged again. The process was labor intensive and could not be supported by the labor force that we had, hence the team was made ineffective.

Research data collected on exercises like this one are very important. In the section dealing with problems and recommendations we will discuss how we can ensure a successful data collection next time.

4. ECONOMICS OF THE EXERCISE (One Malawi Kwacha approximately = One U.S. Dollar):

The culling operation had both an expenditure side and a revenue side. On the side of expenditure, there are several aspects that have to be analyzed.

a. Materials and Equipment:

Materials and equipment of varying nature were necessary in accomplishing this exercise. Each team as outlined in the organization section needed some materials and equipment.

(i) Field Team:

The materials and equipment needed by the team were: a Land Rover for transport and necessary fuel, battery for the spotlights, spotlights, guns (.220, .300 and .270) and associated ammunition, and a knife for the Moslem to cut nyala throats with. Fortunately, most of this equipment and materials were already purchased during the culling operation of 1981. Materials and equipment that were still unavailable were: battery for powering the spotlights, ammunition, and spare bulbs for the spotlights. Spotlight bulbs burnt out frequently. A battery was not bought. Instead the battery on the Land Rover used in field operations was used concurrently to supply power to the spotlights. Therefore, the costs incurred by the field team were for purchase of ammunition, spare bulbs and fuel costs. The cost of fuel will be included with the transport costs in the appropriate section. Another item directly costed to the field team was s istence allowance claims by the marksman who was operating away from his tation. The costs incurred by the field team are summarized in Table 1.

(ii) Skinning and Skin Preservation Team:

The skinning and skin preservation team needed knives for skinning and scraping the skins, salt and Tixol (cattle dip) for preservation of the skins, empty drums in which the cattle dip or brine solution would be put, sisal rope for stretching the skins in the drying shed, and insecticides for protecting the skins from beetle attack in the storage shed. A drying shed had to be constructed for drying the skins. Thus, the skinning and skin preservation team incurred costs of purchase of materials and equipment and also transport to collect various materials.

All the materials and equipment listed above were bought, except Tixol (cattle dip), which was donated by the Department of Veterinary Services. Costs for materials and equipment used by the skinning and skin preservation team are summarized in Table 2.

TABLE 1

SUMMARY OF COSTS INCURRED BY THE FIELD TEAM IN THE CULLING OPERATION OF 1983

ITEM	COST
797 rounds .300 ammunition at K0.58 per round	K462.26
40 rounds .270 ammunition at K0.54 per round	21.60
37 rounds .303 ammunition at K0.51 per round	18.87
105 rounds .220 ammunition at K0.45 per round	47.25
2 bulbs for spotlights at K4.57 each	9.14
Subsistence allowance claims by the marksman at K1.50 per night for 45 nights	67.50
TOTAL	K626.62

TABLE 2

SUMMARY OF COSTS FOR MATERIALS AND EQUIPMENT USED BY THE SKINNING AND SKIN PRESERVATION TEAM DURING THE 1983 CULLING OPERATION

ITEM	COST
1,050 kgs kitchen salt at K0.19 per kg	K199.50
6 skinning knives at K1.10 each	6.60
48 kgs sisal rope at K3.70 per kg	177.60
12 tins strike (insecticide) at K1.85 each	22.20
4 empty drums at K15.00 each	60.00
3 scraping knives at K15.00 each	45.00
TOTAL	510.90

(iii)   Meat Sales Team:

This team needed balances for weighing the meat.   These were already available.

(iv)   Research Team:

This team did not need any new materials and equipment.   Tape measures, weighing balances, etc., were already available.

b.   Transport Costs:

The bulk of the cost was on transport and personnel.   Transport costs included fuel for running the vehicles and maintenance costs.   In its operation, the field team used to drive on a defined road while flashing the spotlights from side-to-side in order to spot animals.   Usually animals were spotted out of shooting range from the road, hence, cross-country driving was a common feature.

This exercise of on- and off-road driving led to severe strain on the vehicle.   This vehicle had to be maintained regularly.   Fuel costs were also high since most of the driving was cross-country using low gears.

Transport costs are summarized at a per kilometer cost in Table 3 below.

TABLE 3

SUMMARY OF TRANSPORT COSTS INCURRED
DURING THE 1983 CULLING OPERATION

ITEM	COST
4,296 km by Land Rover at K0.32 per km	K1,374.72
666 km by Lorry at K0.40 per km	266.40
Purchase of spares	190.24
Travel warrants	22.40
TOTAL	K1,853.76

TABLE 4

PERSONNEL COSTS INCURRED DURING THE 1983 CULLING OPERATION

EMPLOYEE	COST
1 Wildlife Management Officer (P.O.) at K10.78 per day x 45 days	K 484.87
1 Wildlife Control Officer (T.O.) at K4.76 per day x 45 days	214.12
1 Senior Clerical Officer at K4.95 per day x 45 days	222.75
3 Game Rangers (T.A) at K2.85 per day each for 45 days	384.75
1 Wildlife Research Assistant (T.A.) at K2.44 per day x 45 days	109.87
1 Storeman at K1.00 per day for 45 days	45.00
1 Head Game Scout (SC.II) at K1.97 per day x 20 days	39.40
4 Game Scouts (SC.III at K1.34 per day each each for 45 days	60.30
1 Driver at K0.21 per hour for 382.5 hours	80.32
1 Plant Operator at K0.35/hr. for 187 hours	65.45
1 Plant Operator at K0.21/hr. for 195.5 hours	41.06
4 Porters at K0.72 per day for 45 days	129.60
1 Capitao (C.W.III) at K1.00/day x 45 days	45.00
10 Laborers (Unclassified Workmen) at 70t/day each for 45 days	315.00
TOTAL PERSONNEL COSTS	K2,478.69

c. Personnel Costs:

A number of people were employed specifically for the culling exercise while the bulk of the personnel involved in the exercise were people who would otherwise had been engaged on other duties. Only six people were employed for the culling exercise being paid K0.70 per day. The six people were far from enough to carry out the exercise. To give a true picture of the expenses incurred on the culling exercise for paying personnel, we will include people on permanent establishment and nonestablished people employed for other purposes. This analysis will give a true picture of the total force required for a successful operation. The personnel costs are summarized in Table 4. A total force of 32 people is required for a successful culling operation. Of the 32 people, at least three should be of the rank of S.C.O. or S.T.A. and above, and four of the rank of T.A. or C.O.

Engagement of personnel on permanent establishment and nonestablished personnel who would have been engaged in other exercises were it not for the culling operation resulted in disruption of other programs. If other programs were to be carried out while the culling program was in progress, employment of more laborers was mandatory but was not met due to financial restraints as will be discussed in the section dealing with problems and recommendations.

We have discussed costs incurred on materials and equipment, transport and personnel. The total costs for the whole operation amounted to K5,469.97 (Table 5). We now turn to the revenue side.

TABLE 5

TOTAL COSTS INCURRED DURING THE 1983 CULLING OPERATION

ITEM	COST
Transport and purchase of spares	K1,853.76
Materials	520.04
Ammunition	549.98
Personnel	2,478.69
Subsistence allowances	67.50
TOTAL	K5,469.97

Revenue was generated from sale of meat, skins and horns. A total of 840 nyala (344 adult males, 353 adult females and 143 juveniles) were killed. Revenue collected as at 30th December, 1983 was K13,407.84 from sale of meat, K74.00 from sale of skins and K300.00 from sale of horns. There are still 238 adult male skins, 311 adult female skins, 130 juvenile skins and 219 pairs of horns unsold. The value of the unsold trophies is K8,803.00. There are also some items that were collected on credit for which money has not been recovered (K4,309.73). Items collected on credit include nyala meat and skins. Therefore, the total revenue from the operation is estimated at K26,894.57 assuming all the remaining trophies will be sold and all money owed by debtors will be recovered. The problems of marketing will be discussed in the recommendations section.

Comparing the costs and the revenue collected reveals that a net profit of K8,469.97 was realized. If all the products will be sold, then the profit will be as large as K21,424.60 (Table 6).

TABLE 6

SUMMARY OF THE ECONOMICS OF THE 1983 EXERCISE

REVENUE		COSTS	PROFIT	
Actual Cash on Hand	Potential	Actual	Actual	Potential
K13,781.84	K26,894.57	K5,469.97	K8,311.87	K21,424.60

5. PUBLIC RELATIONS:

In an opinion survey in areas around the park, we found a range of feelings from different groups. The people were asked whether they had knowledge of the culling operation, whether they normally went to buy nyala meat from the park, what their feelings were towards the low price of nyala meat compared to goat meat, what was their view with regard to the fact that people are arrested when they go hunting in the park and yet park officials were killing the animals, what they felt about the system of selling meat at Lengwe, and what general comments they had on the operation. Our targets were village headmen, party officials, butchermen and restaurant owners. The feelings from the different groups of people were varied.

We have to say from the outset that our sample was very small, largely due to lack of cooperation from the public since they doubted the intent of the interviews. The few positive responses that we got, however, give an indication of what the public's feelings are.

a. Village Headmen:

Only one village headman around the park was available for interview: Village Headman Ndakwera. Three other villages were visited but the village headmen were not there. At one village--Tomali village--the village headman was sick, and, hence, was not available for interview. Village Headman Ndakwera said he knew about the culling operation and knew the reason why the animals were being killed, i.e., overabundance. Regarding the price of nyala meat compared to goat meat, he said that the price was reasonable, however, the people of his village did not go to buy meat from Lengwe for fear that if they were found with game meat in their houses they would be arrested. On the question of the system of selling nyala meat at Lengwe, he said the system was unsatisfactory since people whose villages are far from Lengwe camp could not have access to the meat due to the long distance (Ndakwera Village is about 14 km from Lengwe camp). He suggested that meat should be sold at some village centers to reduce the distance.

The important point to note about this interview is that the people whom we intended to serve, i.e., the local people around the park are not benefitting fully from the exercise. However, people whose villages are close to the park, i.e., Mphampha (one km), Tomali (three km), Kampani (four km) and Biliat (five km) used to come to buy meat.

b. Butchermen:

The views from the three butchermen interviewed were different from those of village headmen. The butchermen's views were also varied depending on the location of the butchermen's business in relation to Lengwe camp.

The butcherman at Ndakwera, Mr. Abisolumu, and the butcherman at Tomali, Mr. Chalre, said they knew about the culling operation and the reason it was being carried out. The two butchermen differed in their opinion on the low price of nyala meat. The butcherman at Tomali said he was not happy with the low price since it affected his market grossly. He was of the opinion that the price of nyala meat should be increased to at least match that of goat meat, i.e., from 60t/kg to at least 66t/kg. Mr. Chalre, butcherman at Tomali, also commented on the selling system pointing out that it was bad since the local people had to wait for long periods while customers purchasing whole carcasses were being served. (People buying whole carcasses normally came from distant places--Blantyre, Zomba, Lilongwe, Thyolo, etc.)

The butcherman at Ndakwera, Mr. Abisolumu, said the operation did not affect his business since the people could not walk long distances to buy the meat from Lengwe. However, if the meat was taken to points close to his business place (Ndakwera) he would be affected adversely.

Mr. Ishimael, butcherman operating at Nsaje Boma, said he had no idea about the culling operation at Lengwe. However, when the operation was explained to him he said his business would not be affected since the distance was too long (about 130 km from Lengwe camp) unless the meat was transported to Nsanje Boma. He further pointed out that even if the meat

was transported to Nsanje his business would not be grossly affected since many people would be afraid to eat meat from an animal that they did not know, at least initially.

c.   Restaurant Owners:

Miss Rosemary Kachala of Giyana Restaurant at Nchalo (20 km from Lengwe camp) was interviewed. She said she knew about the culling operation and would have been happy if nyala meat was sold to them so that they could serve it in their restaurant since they would make more profit. She said many people would be interested to taste "game meat" and, hence, the restaurant would make good business. However, transport was a big restraint and they did not have chances of obtaining the meat.

d.   Party Officials:

The one party official interviewed did not give any constructive response probably due to fear. He denied any knowledge of the culling exercise and yet he was in the same village as the village headman we interviewed. Even after the operation was explained to him, his answers were not constructive. His response is best disregarded.

e.   Consumers in General:

People coming to buy meat from Lengwe were not interviewed specifically. However, from conversations with some of the customers, it was clear that all the people knew about the operation but some people did not know the reason why the animals were being killed. Some people thought the primary aim of the exercise was to raise revenue for the government rather than reducing the number of nyala for ecological reasons.

Regarding the pricing of nyala meat, the people were very happy about the price. People came all the way from Blantyre to buy nyala meat particularly during weekends. We also had customers from Zomba, Thyolo and Lilongwe not forgetting people from within the Lower Shire Valley, i.e., Chikwawa and Nsanje.

The only complaint was from residents of Nchalo, Ngabu and Chikwawa Boma who did not have means of transport to come and collect meat from Lengwe. They would have liked the park to have provided transport to sell meat at these places. Transport was provided on a few occasions when all the meat could not be sold at Lengwe. On these occasions, the market proved to be very good and the people were very happy.

6.   EFFECTS OF THE CULLING OPERATION ON BEHAVIOR AND DISTRIBUTION OF ANIMALS IN THE PARK:

Culling was done at night to minimize wariness in the animals during the day for the benefit of game viewing enthusiasts, i.e., so that the animals should not associate vehicles during the day with danger but rather associate light and vehicles at night with danger; hence, they would elicit normal behavior during the day. Nonetheless, the animals were wary to some extent. When a vehicle approached, the animals would stand and watch for a while and then flee. This behavior was particularly evident if the vehicle

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used was a Land Rover, indicating that the animals associated the sound of a Land Rover with danger. In cases where vehicles of other makes were used, wariness was rather reduced. Nyala antelopes were the only species that exhibited this behavior. Other species showed no change in behavior. By and large the conventional tourist experience was affected when it came to viewing nyalas.

During periods when culling stopped the behavior of nyala returned to normal after one week of no shooting. They apparently adjust very quickly.

Another effect of the culling operation was concentration of nyala antelopes in the main thicket particularly around the main hide water hole. Culling was done using a Land Rover and most of the driving was off road to get to the animal or group of animals. This cross-country driving was only possible in thicket clump, woodland savanna and dambo grassland vegetation types. The populations principally affected were those inhabiting these vegetation types. Nyala antelopes in the main thicket were not affected as much. This selective removal of nyala in the thicket clump, woodland savanna and dambo grassland vegetation types led to a concentration of nyala antelopes in the main thicket.

During the 1983 annual game count by the National Fauna Preservation Society of Malawi (NFPS), the proportion of animals drinking at main hide water hole was much larger than that of other years (80% compared to the usual 63% to 66%). This change in magnitude of the proportion of nyalas drinking at main hide water hole was attributed to the culling operation, i.e., the populations around North-thicket, Jasi and Makanga water holes were selectively reduced by the culling operation and/or the animals in these areas retreated into the main thicket (Bell and Banda, in prep.). Jasi and Makanga water holes are located in the woodland savanna vegetation type while North-thicket water hole is in the interface of the thicket clump vegetation type and the thicket vegetation types. The location of the North-thicket water hole is not very different from that of the main hide water hole, but the concentration of animals was much higher at main hide water hole. This high concentration of animals around the main hide water hole is partly due to the fact that it falls within the one km radius of the nonhunting zone around the tourist center in addition to its location in the main thicket.

The importance of the observation that animals are concentrated in the main thicket is that we are failing in our objective using the present system of culling, i.e., using motorized transport and also having a one km radius nonculling zone around the tourist center. The thickets that have been opened up are those east of the Link Road where the main hide water hole is located. Furthermore, bare ground is more pronounced in areas in the immediate vicinity of main hide water hole as compared to other areas in the park. Ideally, we would like to have the animals dispersed over a larger area to minimize and/or spread the impact on the vegetation, hence, giving a change to the environment in general to recover. The amount of nyala activity in areas around main hide water hole has to be reduced significantly. But, the culling operation had the reverse effect, i.e., it concentrated the animals in the main thicket. The operation made populations colonizing new areas retreat into the main thicket hence making matters worse rather than better. The system used has to be changed if we

are to disperse the animals over a larger area of the park. We will discuss this subject further in the problems and recommendations section.

7. PROBLEMS AND RECOMMENDATIONS:

We have described the operation in general, equipment used, economics of the exercise, public relations, data collection, and effects of the operation on behavior and distribution of animals in the park among others. We also pointed out problems encountered in the different sections. We will now reiterate the problems and give our recommendations as to how the problems can be avoided (resolved) in the future.

a. Financial:

Inadequate funding for the operation was a cause of many problems encountered. We could not employ sufficient people for efficient operation because there were no funds to pay the extra people. As a result, we had to suspend other services and use people who would otherwise be working on other projects. Research data could not be collected because the labor force was small, and, hence, weighing and reweighing of carcasses would have been a big drain on the energy of the few people who had to do the skinning. On the side of serving the public, we have been criticized for preferential treatment when it came to meat sales as people who wanted full carcasses were served first. But this preferential treatment was not by design but rather forced upon us by the circumstances. There was only one person handling cash, one person reading the scale, and two or three people doing the weighing. With such a labor force it was not possible to serve people wanting a few kilograms together with people who wanted whole carcasses. To serve people who wanted only a few kilograms of meat, we needed to cut up the carcasses into small pieces and weigh the desired amount for each individual. This process was time consuming and labor intensive. To serve people who wanted whole carcasses, on the other hand, we only needed to weigh the carcasses and load them on vehicles, a process that was much faster. Ideally, we ought to have served the people on a first come first served basis but to do this we needed more people, equipment, and hence more money.

Transport was yet another problem. Our public relations objective, i.e., to change the attitude of the local people towards conservation areas, dictated that we should have at least once in a while sold some nyala meat at local markets such as Tomali, Ndakwera, Therere, etc. To accomplish this exercise we needed more money to fund the transport and buy more balances to be used by the different teams. We also needed more people. If we sold meat at some of these locations more of our desired public, i.e., subsistence farmers around the park would have benefited from the exercise.

No funds were provided for the 1983 culling operation. Money allocated for other purposes had to be channelled to this exercise. Such an arrangement is unsatisfactory. Therefore, our first recommendation is that funds should be provided specifically for the culling operation. Five thousand Kwacha (K5,000.00) would be needed for a successful operation. Since the operation is a revenue generator we recommend that a treasury fund should be set up to provide for greater flexibility.

b. Organizational:

There were a lot of organizational problems during the 1983 culling operation. In general, the operation was carried out on a management by crisis basis, i.e., no proper arrangements were made until the last minute.

The operation was nearly terminated by lack of ammunition. The rifle recommended for culling nyala antelopes is a .270 caliber gun (Kamvazina 1981). But at the time the operation was due to start, there were no rounds of .270 ammunition. As a result .303 caliber and .220 caliber guns were tried but the former was too noisy and the latter was found to be ineffective, i.e., several rounds were needed to kill one animal. Fortunately, a private individual initially loaned the department his .300 caliber gun and a few rounds of ammunition and finally he donated the gun to the department and also the ammunition he had in stock. It is this gun that was used throughout the operation. Since the gun was initially loaned to the department only a few rounds of ammunition were given at a time causing a lot of unnecessary breaks in the operation. These breaks increased expenses in that the marksman had to be driven back to Blantyre each time we ran out of ammunition and collected again when some more rounds were available. The meat inspector was also from Blantyre.

The .270 ammunition was ordered too late. It got to Lengwe towards the end of October. At that time the animals were too wary and their condition had begun to deteriorate. Furthermore, there was great need to resume the projects that were disrupted due to the culling operation. It was decided that the culling operation should stop even though we were still 160 nyalas below the target of 1,000.

The breaks also had another effect in that animals were harassed for a longer period due to the extension of the culling period. If the animals were shot in as short a period as possible, so much the better.

Another point regarding organization was poor communication between the Department of National Parks and Wildlife and the Department of Veterinary Services. The Department of Veterinary Services was to send a professional officer to carry out various investigations. Arrangements, we understand, were made between the national parks headquarters and the Veterinary Services headquarters but the agreements made were not communicated to the field officers with the consequent result that nothing happened. This situation was very unfortunate. We are sure it arose due to the fact that arrangements were rushed.

A proper vehicle for the operation was not available at the start of the operation. A vehicle that had been considered unsuitable during the 1981 operation was again issued for purposes of carrying out the operation. It was again unsatisfactory and was replaced in the course of the operation by another vehicle which was better but not ideal. This was again due to inadequate planning.

Our second recommendation is that sufficient time should be given for planning the exercise between headquarters and the officers to carry out the exercise on the ground so that all necessary arrangements are made and all equipment is ready before the exercise begins. Planning should start at least three months ahead of time.

c. Equipment and Facilities:

Lack of proper equipment and inadequate facilities presented other problems. For efficient operation we need to have certain facilities and equipment.

(i) Abattoir:

An abattoir is a necessity especially in view of the fact that culling will be a regular activity in Lengwe. Currently, the mechanical workshop is being used as an abattoir. This arrangement is unsatisfactory since the mechanics cannot work while meat is being sold. Hence, we concur with the recommendation of Kamvazina (1981) that an abattoir be constructed at Lengwe. This recommendation is our recommendation 3.

(ii) Cold Room:

A cold room is a necessity. When meat cannot sell within a day, it can be stored in the cold room. Another advantage of having a cold room is that the period of culling can be reduced substantially. During the 1983 operation, the number of nyalas killed per night was dictated by the expected demand on the day following. With a cold room demand on a particular day will be of little relevance since the meat can be stored if not sold immediately. We, therefore, concur with Kamvazina (1981) and recommend that a cold room be provided. Recommendation 4.

(iii) Tannery and Trophy Storage Shed:

Storage of skins presents several problems. Due to inadequate space, skins are packed in a small shed where it is difficult to spray insecticides. This situation leads to deterioration of skin quality.

Another problem is the market for the dry skins. Few people are prepared to buy untanned skins. It is, therefore, important that we start tanning the skins to attract a wider market. A tannery is necessary.

If we are to carry out large scale tanning, it is important that one of the officers in the department should be trained in the art of tanning.

Our fifth recommendation is that a tannery and skin storage shed is constructed. We also recommend that at least one officer from the department is trained in the art of tanning; this is our recommendation 6.

(iv)   Transport:

Transport presented a lot of problems. Breakdowns were commonplace leading to breaks in the operation. Sometimes we could not meet the demand for nyala meat on a particular day due to vehicle breakdowns and we had angry customers to greet the meat sales team in the morning. We need to avoid such situations. We, therefore, recommend that two reliable vehicles should be allocated to the operation so that if one breaks down there is one on standby to ensure continuity in the operation. This is recommendation number 7.

d.   Public Relations:

In pursuance of the objective that we improve the local public's attitude towards national parks and game reserves by having the local public benefit from reduction exercises for overabundant species, it is necessary that meat from nyala culling should be made available to subsistence farmers around Lengwe National Park. At present meat is only sold at Lengwe camp, hence, most of our desired public is not served. We, therefore, recommend that meat should also be sold at some local centers and villages to ensure that those people who do not have adequate means to get to Lengwe also have a chance of buying nyala meat. This is our recommendation 8.

e.   Culling Techniques:

The present culling technique of driving and shooting raises certain problems at night. The only areas where nyala can be shot are those accessible by vehicle; consequently, animals find a safe zone where they concentrate. Another factor conducive to concentration is the closing out of an area of 1 km radius from the tourist camp as a nonhunting zone. Nyala antelopes tend to concentrate in this safe area. The problem with this concentration is that the impact is localized in areas that are already highly affected, e.g., areas around main hide water hole. We need to reduce the population in these high concentration areas.

Our ninth recommendation is that the park should be closed to conventional tourism for two weeks at the beginning of the operation during which time hunting will be done in all areas with particular emphasis on the thickets east of the Link Road which includes the areas around main hide water hole. Hunting in the thickets may have to be done on foot. Therefore, the hunting period should be adjusted during those two weeks to include early morning hours and early evening hours. This system of hunting in the thickets will be on a trial basis initially.

The hunting period in 1983 was extended over a long period due to the different problems discussed above, i.e., organizational and transportation problems. From the end of August onwards, the condition of the animals declines and also many females have fetuses. Therefore, it is not a good time for culling. Meat quality is low, hence, will not sell easily. The predominance of females with fetuses among the dead is aesthetically displeasing.

We, therefore, put in as our tenth recommendation that the culling operation should start at the beginning of June and end by the middle of August.

8.   CONCLUDING REMARKS:

Culling of nyala antelopes is a very exacting exercise requiring dedication and organization. For a successful operation, appropriate equipment and the facilities are needed. Furthermore, significant capital costs as well as recurrent costs are involved. In the nyala culling operation of 1983 in Lengwe National Park, inadequate funding, lack of adequate equipment and facilities, and organizational problems were a cause of great strain on the people involved in this exercise. Patience and dedication were the only tools that ensured a successful operation. Although the animals shot fell below the target of 1,000 by 160 animals, the number taken under the circumstances described above was substantial.

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CHAPTER 18

COMMUNAL AREA MANAGEMENT PLAN FOR INDIGENOUS RESOURCES (PROJECT CAMPFIRE)

BY

R.B. MARTIN

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1. INTRODUCTION:

This paper gives a brief description of the Communal Area Management Plan for Indigenous Resources (Project CAMPFIRE). The planning of this project was initiated by the Department of National Parks and Wildlife Management, Zimbabwe, in late 1982. It has now gained full government approval and will shortly commence active operations.

The purpose of the program is to provide a mechanism for the rational utilization of natural resources (primarily grazing, wildlife, forestry and water) as a complement to agricultural development by rural communities in communal lands of marginal agricultural potential.

The objectives of the program are as follows:

a. To initiate a program for the long-term *conservation* of *natural resources in communal areas*.

   Specific resources are forestry, grazing, water and wildlife, and the initial target area is the Northern Sebungwe. The program would be *voluntary* and remote communities can opt to join it.

b. To achieve management of the resource by placing custody and responsibility with the resident communities. The program aims to assist each community in setting up a *land company* in which the *shareholders* are the adult members of the community and the *board* is run by the community, with outside representation from key government agencies.

c. To establish *regional* and *national boards* and an agency to coordinate the activities of such community companies. The agency is to be seen as an economic institution open to ultimate *capture by member communities*. It has a dual character in that technical sanctions are retained in the hands of official representatives in order to secure the accountability function over the use of national and communal lands, and of public funds.

d. To *negotiate* the entry of communities to the program under conditions appropriate to each area. Under the program, each community would receive *initial aid* in the form of protective *fencing* around *consolidated arable areas*, and the *communal resource area* would be delineated as the surrounding area. Internal rules would be reorganized so that the community operates as a territorial land and asset management association.

e. To provide technical assistance in devising *management strategies* appropriate to each resource (wildlife, forestry and grazing), through participation funds, the means to implement utilization schemes considered sound in the long term.

f. To enable communities to *benefit materially* and *financially* from the wise exploitation of communal resources through their own involvement in management.

g.   To promote community *self-reliance*, and lifestyles and land use
in harmony with the natural constraints of marginal environments.

2.   BACKGROUND TO PROJECT CAMPFIRE:

Project CAMPFIRE arose from a regional land use plan for the Sebungwe
Region of northwest Zimbabwe, see Martin and Taylor (1983).

A prime concern of the Sebungwe Regional Study Group was the growing
problem of land use and resource management in the remote marginal lands in
the north of the region. These problems are not unique to the Sebungwe and
the project has application in many parts of Zimbabwe. The Sebungwe study
has identified the better arable areas of the region where the land use is
primarily dryland cropping. Outside of these arable areas, many conflict
situations exist where several land uses might be practiced.

This program is directed mainly at communities in the north of the
region where there are few extensive arable areas, infrastructure and
communication are poor, and much of the land is broken country. Communi-
ties suffer heavy crop losses due to wildlife, and conversely, the wildlife
resource is subject to heavy poaching. Due to population pressures, there
is a steady northward encroachment of settlers who are forced to occupy
pockets of arable land in an otherwise hostile environment.

The north of the region is infested with tsetse fly and there is
little or no livestock. It is logical that the wildlife resource should
replace cattle until the fly is cleared, and it may have a significant role
in the marginal areas even after the fly has gone. Considerable progress
has been made with the fly front in recent years and cattle are rapidly
being introduced to cleared areas. There is urgent need for intensive
cattle management if the Sebungwe is to avoid the overstocking and the
overgrazing which has caused degradation elsewhere in the communal lands of
Zimbabwe.

With the advance of settlement into the remoter parts of the region,
the indigenous forest resource is threatened. In many cases, woodland has
been cleared from poor shallow soils to provide crop land which is unlikely
to remain in production for more than one or two years. The demand for
firewood and poles will soon surpass the sustained yield level of the
natural woodlands and, without careful husbandry or the planting of exotic
woodlots, the time will soon be reached where alternative energy sources
have to be found. This program is, therefore, concerned with four main
indigenous resources: *forestry, grazing, wildlife* and *water*.

None of these resources lend themselves to individual ownership when
found on communal lands, although they may be owned when found on large
commercial ranches. Nevertheless, it is the very lack of ownership that
make the resources vulnerable to overexploitation. Because cattle grazing
is free, it is in the short-term interest for individuals to exploit it as
much as possible. However, there are grave injustices in such a system;
while each member of a community should have a stake in the grazing
resource, it is only the cattle owners who reap the benefit. The national
policy towards wildlife is that it belongs to the landowner--except on
communal lands where government remains the custodian pending the readiness

of communities to manage the resource themselves. The result has been that wildlife is viewed as a threat to crops and human safety and a competitor to cattle for grazing. Because no direct legitimate benefits from wildlife accrue to the remote peasant, he poaches game illegally, invariably only for meat. Unfortunately, the full value of wildlife is never realized in this manner and considerable waste occurs. Similarly, forests are regarded as an inexhaustible resource and there are no mechanisms present to restrain overuse by any one group of individuals.

These resources belong to the community at large and the responsibility for managing them should lie with the community living in the midst of them. Furthermore, whatever benefits arise from their custody or exploitation should accrue to that community.

A colonial system of government managed to a lesser or greater extent to operate a centralized system of management and extension over the whole country. In so doing, many remote communities were effectively dispossessed of their rights regarding the resources surrounding them. It is neither desirable nor just in future years for this system to prevail: government will not be able to continue with limited resources to provide universal servicing of all parts of Zimbabwe, and even if it could, there are better arguments for redressing the wrongs of the past and encouraging communities to assume their own responsibility towards conserving their natural resources. A basic flaw in our philosophy to date has been to assume that a powerful agency could carry out the necessary conservation for the nation: in the long run, conservation will work only when each community has a direct stake in managing the resource and justly benefiting from its activities.

This proposal is strongly founded on the tenets of World Conservation Strategy. It fully recognizes the need for development and aims to promote appropriate resource management to serve development. The program is humanistic in that it proposes that resources should serve people on a sustained basis, and the solutions for remote areas lie in full involvement of the communities living there. To maximize the long-term prospects for such communities, a diverse range of land use strategies should be explored, and lifestyles should be appropriate to the constraints imposed by natural factors in the region.

Many projects are founded on the premise that a research team should visit the communities in the field, find out about their needs, return to base and come up with a set of solutions to the problems. This program is somewhat different. Firstly, communities may have different levels of perceiving their problems, and too often many of the answers that are given to research teams may present a simplified picture when problems are in fact far more deeply rooted. Secondly, all solutions to problems must take into account the resource base which is to support them, and the "visiting team" must clearly understand the limitations of the environment surrounding the community in considering the applicability of any "solution." Thirdly, the regional nature of problems must be taken into account. Whilst one community might perceive that the answer to their difficulties might lie in eliminating all wildlife in their area or in the construction of a major road, the solution must be evaluated with an overview of the effects on adjacent communities.

The approach to be taken in this project is that the broad objectives have already been determined and a rough program of steps to reach those objectives has been drafted. However, rather than impose this program on communities, the program is a voluntary one, and those communities who see that many of their problems might be solved by opting to join the program would do so. They would not necessarily be compelled to accept the program in its entirety, but could negotiate a particular settlement appropriate to their needs within budgetary limitations, and in accord with the broad goals of the program. The principal aim of the program is not to "lay down the law" for communities, but rather to attract their participation and strengthen the communities' position by promoting self-reliance. This will be done by negotiation, rather than by research or by edict. For all the reasons given in the preceding paragraphs, a new agency is required to carry out the implementation of the program.

The inevitable question will be asked: "If population increase continues unabated, how can a program of this sort ever hope to achieve conservation of natural resources?" An immediate answer might be that nothing can avert disaster in this ultimate event, but it should not preclude all reasonable attempts to protect the environment and maximize its potential for human survival.

There are mechanisms built into the program to manage natural resources in such a way that there is a strong negative feedback operating against the processes of overexploitation.

First, by placing territorial boundaries to communities, there is an immediate awareness that resources are finite and strategies for survival must be found within the confines of the community territory.

Second, in the management program for each resource (wildlife, forestry and grazing), there would be strong incentives for communities to avoid overexploitation by placing limits on individual activities which threaten resources. These are discussed more fully in later sections.

Lastly, the program offers the potential to communities to greatly improve their present lot, and by so doing must inevitably slow down the processes leading to land degradation. While there is no attempt to arouse false hopes in the minds of people that an immediate "bonanza" can be made out of their new relationship to natural resources, there is every encouragement to maximize sustained returns from marginal land.

3. FUNDING AND ORGANIZATION:

a. Project Funding:

The bid for funds under the PSIP comprises several different types of financing.

(i) A foundation grant is required to meet the main capital outlay of reorganizing communities into fenced consolidated areas. Equipment for the new agency, vehicles and professional assistance would also be paid for from this source which would hopefully be donor aid.

(ii)   A participation fund is required to engage the communities in ventures consistent with the resource management program. Certain initial contractual obligations to each community (e.g., game-proof fences around arable land) would be met from the foundation grant: thereafter, communities which are anxious to initiate projects (e.g., a wildlife industry involving leather tanning and meat processing) would apply for the starting capital from the participation fund. The fund would operate on a basis where a proportion of profits were returned to the fund for further agency use in extending the program.

(iii)   Government recurrent expenditure would meet the salaries of agency staff and running expenses such as subsistence, transport and maintenance.

It is important that funding is adequate at all stages to meet possible demands created by communities opting to join the program. It is government's responsibility to meet the obligations which the program creates.

b.   The National Board:

At the start of the project, a board would be set up under the Ministry of Natural Resources with a composition roughly as follows:

Chairman: Secretary for Natural Resources

Members: Department of Agritex

Forestry Commission

Department of National Parks and Wildlife Management

Ministry of Local Government and Town Planning

Ministry of Finance, Economic Planning and Development

Ministry of Lands and Resettlement

Three Ministerial Appointees

Chairman of Regional Boards (three or four)

Agency Project Leader

The functions of the national board would be to provide an overview of operations on a country-wide scale and act as a forum for regional boards to compare notes and exchange ideas. Any major changes to the nature of the program would require the approval of the national board.

c.   **Regional Boards:**

Members: District Administrator(s)

District Council Chairman(men)

Chairman of Member Communities

National Parks and Wildlife Management

Forestry Commission

Agritex

Agency Project Leader

The chairman of the regional board would be elected from board members, and, hence, the principle of capture by member communities is enshrined from the start.

The function of the regional board would be to guide plans prepared within the framework of national policy. District councils and administrators would, thus, be fully in the picture and able to provide advice and incorporate the agency activity within local government planning. This would lend political legitimacy to the agency work, rather than hinder it, and assist in coordination of other infrastructural development in the region.

d.   **The Agency:**

For reasons explained in the introduction, a separate agency is necessary to implement the program.

Initially, the agency could function as a "spearhead team" to carry out dialogue with the target communities. During this phase the program would be refined to suit local conditions and negotiations would lead to communities joining the program.

Once communities have joined the program, the responsibilities of the agency would be:

(i)   To implement the initial provisions negotiated under contract with the communities (e.g., organize installation of fences around arable lands).

(ii)   To provide ongoing technical and administrative services to member communities.

(iii) To provide initial investment and resource management plans and assist, when requested, with community discussions.

(iv)   To provide bookkeeping, managerial and audit services.

The agency should ensure that its capacity exceeds the demand for services. It must keep promotional and service activities separate in order to determine a reasonable cost structure covering participation fund ventures and social overhead charges carried by government. The agency should assist with training of individuals from member communities and help finalize plans and budgets. It would liaise with the Registrar of Cooperatives.

For the first year of the project, the staff would consist of:

(i)   Project leader: who is a mature person with a qualification in economics and/or ecology and considerable experience in dealing with people. He would be required to comprehend the full strategy of the project, and be capable of decision making at a high level. His judgement of the feasibility of schemes requested by communities and the appropriate participation fund capital required would be a key factor in the success of the program. He should also possess a strong sense of dedication to the conservation issues at stake and have a firm commitment to Zimbabwe.

(ii)   Graduate assistant who might be a sociologist or have a technical qualification. His prime function would be to assist the project leader.

(iii)   Senior field operator whose function would be to brief and control field assistants and collate their information.

(iv)   Field assistants (numbering four in the first year, and increasing as demanded by the program) who would be recruited from the target areas. These staff would have a minimum of RJC education, preferably "O" levels or higher. They would be trained in Harare and would return to their areas to carry out discussions and negotiations.

(v)   Bookkeeper/secretary/typist to maintain office routines initially, but later to take on bookkeeping to member communities.

The agency would be responsible to the national board and would liaise closely with the regional board. Under the principle of capture by member communities, it is envisaged that as the program gains momentum, it would be necessary for the agency to form regional sections and these would eventually be taken over by communities.

e.   **Member Communities/"Land Companies"/Society:**

On joining the program, member communities would be required to reorganize their internal rules so as to operate as a territorial land and asset management community association. For brevity, this will be referred to hereafter as the "land company."

The organizational steps to be taken within the community in order to qualify as a participant group in the program are as follows:

(i)   To form a company which has as its membership all adult males and females in the community. The company would have a board consisting of about eight community members, of which all are elected except perhaps the ward District Councilor who would automatically sit on the board. In addition to community members, government would be represented on the board by technical staff of Agritex, Forestry and National Parks. Since it would be impractical for representatives of all of the agencies to be present on all boards in the region, the most likely method of operation will be for one member of one agency to sit on several boards most of the time holding a watching brief for the others. A member of the project agency would also sit on community boards.

(ii)   At the outset, the community would need to decide which resources required management by the society as a whole, and which are the automatic prerogative of individuals. The program would assist in this process by offering to provide electrified game-proof fences to protect the arable holdings of individuals after some consolidation of lands had taken place. Very simply, all land within the fenced areas might be individually owned, while that outside the fences would form the communal resource area, which is managed by the land company. The community would decide on limited automatic rights for individuals including residential plots, vegetable allotments and forest stands, but there would not be individual right of access to the communal resource area. This land would be exploited under a process of asset management with equal benefits accruing to all shareholders in the company. Typically, the philosophy applies to forestry, grazing and wildlife, all of which would be best managed for group benefit rather than individual gain. The primary assets of the land company would be the natural resources, and membership of the company implies a share in the common assets.

(iii)   Management programs for each of the communal resources would need to be agreed upon with the agency, and the land company would bind its members with rules covering the use of these resources.

        It is important at the outset for the community to realize that, in the main, the communal resource area is marginal land. In all its promotion of the program, the agency must never give the false impression that an "overnight bonanza" is waiting to be realized from a wealth of untapped resources outside the fenced arable areas. Rather, it must emphasize the exact nature of the resources, and point out to the community that a sensible strategy for survival in the long term is to exploit a diversity of resources on a

sustained yield basis to maximize the possible inputs to the community, and minimize vulnerability to single factors in the environment. Typical resource programs might operate as follows:

Grazing: The carrying capacity of the communal resource area for cattle would be determined with technical assistance from Agritex, and the land company would decide that this stocking rate could not be exceeded. To achieve this, it might decide to charge a nominal sum per head of stock using the grazing. Such a move would result in all shareholders receiving a fair dividend from the communal resource.

It would also act as a powerful negative feedback mechanism against any individual who tried to overexploit the resource. His charges for grazing a large number of cattle would exceed any dividend he could reasonably expect from his shareholding in the land company and it would not be in his interests to aim for an excessive number of stock. A second method, which would flow from vesting common properties in the adult membership, is to award each member to trade rights, thereby realizing a price for grazing and a system that compensates those with few or no livestock. Group interest becomes the asset, individual interest the exploitation of the asset. After some time, the land company might wish to introduce an intensive grazing scheme for stock, with correct placement of water points, cattle dips and fenced paddocks plus better veterinary and marketing services. This type of project could be financed from the agency participation fund at the discretion of the project leader, and it would be negotiated that some return of profits would eventually be returned to the fund.

Wildlife: A number of management options would be open to the land company. Safari hunting would be the most lucrative, and several adjacent communities might combine to form a viable safari concession across their communal resource areas. The land companies would derive rules for profit sharing from the venture and exercise the right to meat and game products from animals shot for trophies. However, safari hunting would exploit only a limited sector of the wildlife populations and sustained yield hunting schemes would be practiced, as well as local recreational hunting. Quotas for such projects would be advised by national parks, who would have a technical sanction on any abuse of the resource.

Poaching would have to cease in the area, since it would be an antisocial activity directed against the community itself. The tasks of national parks' control officers would be greatly simplified in dealing with problem animals under the scheme. Their commitment to the fenced arable areas would be absolute and conversely there would be little need

of control outside such areas. (This approach would also act as a strong incentive for communities to join the program.) There is a further implication of the policy of fending arable areas which has regional importance. The need for game fencing around vast tracts of national parks and safari areas falls away, and, indeed, is not desirable. These government lands can act as breeding pools for wildlife to repopulate the communal resource areas for the benefit of communities. This, in turn, would reduce the need for culling operations in parks, and would maintain the vital spatial continuity of wildlife between different parks in the region, thus, preventing them from becoming ecological islands. As part of the program service, community members would be trained as competent hunters with the object of ultimately taking over all control work and hunting themselves. The dangers inherent in this are few, once the concept of community self-reliance and responsibility is fully established. Land companies might wish to establish secondary industries based on the wildlife resource, such as skin tanning, meat processing and fabrication of skin products and artifacts. This, too, could be funded from the participation fund on a percentage return basis. It might not be economical for every community to have its own wildlife processing plant, but it might be feasible for one plant to service several communities. Careful development of the wildlife resource could provide significant employment for individuals in the community and considerable revenue for shareholders.

Forestry: An inventory of indigenous forest resources and an estimate of its sustained yield potential for firewood and poles should be provided as a service under the agency as a first step in devising management plans. It is a relatively simple matter to relate the sustained yield to the size of the community, and decide on the need for action. Depending on the degree of urgency in the situation, the land company might opt for a centralized system of rationing, the protection of certain woodlands, the allotment of individual wood cutting areas or the introduction of exotic woodlots to support consumption. There might exist some potential for commercial timber harvesting such as teak (*Baikiaea plurijuga*) or African blackwood (*Dalbergia melanoxylon*) which is in high demand for musical instruments. Whatever the project, again, it could be financed from the participation fund if it appears worthwhile.

(iv) The community would be obliged to accept territorial limits to its communal resource area, at the same time as accepting custody of the assets. The process of setting boundaries is potentially controversial, but might be resolved by the regional board. The target communities already have nominal boundaries set on all district administration and Agritex maps, and it might involve no more than accepting these as the defined limits. The land company would agree to an

annual payment to the district council in recognition of communal land controlled by the society, and of income derived from membership in a federation of land companies. This payment would be in terms of a royalty and/or a tax on net income.

(v)   Land companies would be required to observe certain general rules approved by the regional boards and national parks board. These might arise from pricing of commodities and practices such as safari hunting, sustained yield quotas of wildlife and common forest felling.

(vi)   Land companies would need to settle procedures for the realization of produce from communal resource areas. This would involve decisions regarding the degree of local processing and distribution and methods of marketing produce. Here, too, the regional board will play an important role in recognizing developing industries and planning for their incorporation into the regional sphere.

(vii)   Land companies would require a declared financial policy at the outset. After fulfilling obligations to outside bodies, revenue might be disbursed as follows:

(1)   20% into a reserve account to be used as starting capital for the next year's operations.

(2)   Dividends to shareholders--not exceeding 50% of annual profit or $500 per member whichever is the greater.

(3)   20% to a community fund to provide services unrelated to the communal resource area.

(4)   10% as long-term investment in Building Society Certificates.

Sudden easy wealth would be a danger to the community. The land company might create a member-controlled savings account, which together with funds in the reserve and community accounts could be used to attract participation fund monies from the agency.

(viii) The land company would formulate its own internal employment policy toward community members employed in connection with land company projects. This would cover eligibility, salary and wage occupations, piece rate payments and contractual functions.

4. THE IDEALIZED WORKING SYSTEM UNDER PROJECT CAMPFIRE:

This concluding section attempts to show the possibilities of a successful program, and to point that it is within the grasp of rural communities to elevate their present position to a highly satisfactory level of lifestyle, given the support of government and their own willingness.

Firstly, it is worth considering the probable long-term future of the marginal lands of Zimbabwe without any significant changes in the current pattern of development. It is not difficult to find examples elsewhere in Africa or in Zimbabwe itself. Increasing population pressure and a long history of colonial neglect has forced people to seek a survival existence in an environment of poor soils, broken country and low rainfall. Instead of the maximum government effort going into a study of survival in the most hostile conditions, the greatest public effort has concentrated on returns from the best land. This in itself might not have been unreasonable, were it not for the process of desertification overcoming the marginal lands and the final outcome where such land could not support life in any form. Overstocking with cattle, cultivation on steep slopes without conservation measures, and destruction of vegetation in water catchment areas have all been part of the degradation process. But, it is important to realize that no rural farmer willingly destroys land: the present situation is an indicator of the extreme pressures that face rural communities who are unsupported in their struggle for survival. Moreover, a long history of effective "dispossession" of the right to natural resources has reduced many rural communities to the level where they are unwilling and uninterested in taking a broader view of their problems.

This program seeks to restore that confidence in the rural sector, to restore and foster a responsible and productive relationship to the common assets and to take responsibility for finding a way out of the present depressed situation. Let us assume that all the infrastructure of the project is working: that regional and national boards are established, that a "live-wire" agency is operational, and that a large number of communities have not only joined the program but have already "captured" the regional board and agency--in short, the program is well advanced. What could we expect?

Communities would be living in well-fenced spacious areas. The losses due to crop raiding by elephant which were such a major factor in the past, have disappeared. This alone has increased the productivity of crops. Because of the consolidation caused by fencing, the task of agricultural extension officers has become much easier in identifying communities and providing extension services. Other services, too, have improved because of consolidation--water supplies, fertilizer delivery, schools, clinics and recreational facilities. The high level of organization has encouraged road building and the district is well-served with a network of adequate roads. Outside the fenced arable land grazing areas are correctly stocked with a quota of strong healthy cattle. Some communities with high pasture potential have installed savory-type grazing management systems with dips and waterpoints, using the backing of the agency participation fund. Through their combined power on the regional board, communities have established a regional marketing system for cattle and there is a regional

abattoir and cold storage facility. As a result, despite the region being classified as a foot-and-mouth disease area, a major problem is not perceived as all beef production is marketed internally. Veterinary services support the schemes to improve the potential pastures and are no rigid demands for expensive measures to counter foot-and-mouth disease are required.

The wildlife resource has become a major revenue earner for communities. With the cessation of poaching, game populations have increased sharply and productivity is high. Safari hunting concessions bring a large number of high-fee-paying international tourists into the area, and this has led to communities looking at other types of tourist potential. Outlets have been found for artifacts and curios unique to the district and highly prized by visitors. One community has gone so far as to build a model village in traditional style where craftsmen produce wood carvings, Batonka stools and axes, which is visited by all tourist hunters.

An active wildlife industry is supported by a sustained yield hunting operation carried out by the villagers themselves. The quotas set by National Parks and Wildlife Management were low at first, but as populations increased and the villagers became actively involved in reporting on game species, the level of off-take was increased. A wide range of operations take place in the wildlife industry plant which employs some fifty workers full time. Meat is prepared in a variety of ways and sold fresh, smoked, dried traditionally or as biltong, and one community is now looking at the possibility of a canning plant. Elephant skin is well prepared and fetches high prices on the market. Soft skins of both wildlife and cattle are tanned, craftsmen with heavy duty sewing machines, fashion karosses, handbags and briefcases for a large profit. No part of the animals is wasted: horns, hooves and teeth are fashioned into curios.

A new development is recreational hunting for community members and Zimbabwean residents. By now the land companies understand the value of each game species and the license fees are set so that it is more profitable for the community to let outsiders shoot some of their game than to do it themselves. Several communities offer "mini-safaris" where kudu, warthog and impala are shot. Visitors are catered for in the village at reasonable rates, and the professional hunters accompanying clients are community members. In all the wildlife operations, one thing is very noticeable: the conflict which characterized the relationship between people and game before the community program was initiated, has now disappeared. Perhaps, it is not surprising: such communities used to live harmoniously with wild animals before a colonial government and growing land pressures combined to deny them access to the resource.

Communities are well aware of the fragility of their forestry resource. Many have declared particular indigenous stands as protected and only dead wood can be collected in them. Using data provided by a forestry expert, some communities have voluntarily opted to ration themselves slightly knowing that this will assure a permanent sustained yield. One land company does the rationing by restricting all firewood collection to employees of the company. Firewood is cut into appropriate bundles and sold to members. Of course, since all members are shareholders, this revenue is returned to them--with one important difference: those

individuals who tended to overexploit to resource, have had a strong negative restraint placed on their activities. Exotic woodlots of blue gums are thriving, and these have almost entirely replaced indigenous timber as a source of poles. The more advanced land companies, who were the first to plant, are now marketing their poles across the district. Several communities found they had significant stands of African blackwood and this is being carefully harvested to supply musical instrument makers in Europe--the profit is very high. On deeper sands there are stands of teak and this is being exploited on a sustained basis for furniture manufacture in Harare and Bulawayo.

The overall picture is one of a powerful group of self-reliant communities working in concert with each other across the regions. Gradually, they have come to control their own destinies to a large extent, and also become a major political lobby which no government can afford to ignore.

In the process, landscapes and resources have been preserved and their is a sound primary foundation for the communities' future. Tourist potential has been secured and aesthetic qualities of life maintained.

The program has the potential to turn many of Zimbabwe's remote areas into model regions for the African continent. The solutions are technically appropriate for local conditions and do not involve adopting alien lifestyles advocated by outsiders with little stake in the future of the country.

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CHAPTER 19

TRADITIONAL USE OF WILDLIFE RESOURCES IN PROTECTED AREAS

BY

R.H.V. BELL

1. INTRODUCTION:

The question discussed in this paper is the question of how to resolve the conflict between the use of wildlife resources by rural populations on the one hand, and the interests of conservation in protected areas on the other. This is, of course, a key question to conservation worldwide; it is a very difficult question, and it is a question to which we do not pretend to have found the answer. In this paper, we merely intend to put forward some ideas for discussion.

2. WHAT IS MEANT BY TRADITIONAL USE?

What we have in mind is the use by rural village people of wild plants and animals, using methods that do not involve advanced technology or extensive commerce. Rural populations have used wildlife resources in these ways for extended periods on a more or less sustainable basis.

The problem in conservation terms, however, is that for several reasons, the exploitation of wildlife resources is no longer sustainable; it cannot continue in an unregulated way without serious depletion or extinction of the wildlife populations concerned, or without damage to the overall environment.

The first, and primary reason for this situation is the increase of the human population, leading to an increasing demand for natural resources. Secondly, the increase of human numbers has been followed by an increase in the area under cultivation, and a consequent decline in the area available for the production of wildlife resources. Finally, the progressive development of rural populations allows them to use technical and commercial methods in the exploitation of wildlife resources that these resources are unable to withstand. In short, the exploitation of wildlife resources is to some extent no longer traditional and this is where the problem lies.

Are we justified, then, in confining our attention purely to traditional uses? We feel that this is a narrow view and that we should now consider the whole question of exploitation of wildlife resources in relation to conservation as it exists in Africa today, including the traditional, the developed and the commercial aspects.

3. USE OF WILDLIFE RESOURCES BY RURAL POPULATIONS:

The use of wildlife resources by rural people falls into the following main categories:

(i)   Use of plant materials for firewood, building poles and food;

(ii)   Use of small animals, etc., for food (i.e., insects, birds, small mammals);

(iii)   Fishing;

(iv)   Use of large mammals for meat and skins, etc.; and

(v)   Use of large mammals for saleable byproducts (i.e., ivory).

The last form of use (i.e., the trade in ivory) is distinctive in character and will be dealt with separately. The remaining forms of use are integral parts of the ecology of rural life in Africa.

It is important to remember that the great majority of people in Africa today are still rural. The majority are self-employed as small farmers or stock owners with relatively little involvement in a commercial or technological economy. This means that a high proportion of their needs must be supplied locally from the bush.

A mistake commonly made by visitors to Africa is to think that the extensive areas of uncultivated land are "vacant" and "unused." This is particularly true in the extensive relatively infertile areas of the Central African Plateau, and the West African Guinea Savanna, where soil fertility and crop production depend on the system of shifting cultivation. In this system, the cultivated areas are shifted regularly, allowing the soil to recover under extended periods of bush fallow. This system adds to the superficial impression that much of the land of Africa is unused.

This impression is none-the-less false. The system of rural agriculture in such areas requires access to large areas of apparently vacant land, firstly because crop productivity is low and depends upon soil renewal through extended fallows, and secondly, because many of the basic necessities of life (i.e., protein, building material, fuel wood and medicines) are unavailable commercially and must be obtained from the bush. This means, as we said earlier, that the use of wildlife resources is an integral part of the ecology of the rural way of life.

We must ask then, what happens in areas which are densely settled, where the bush has all been removed, where there is no room for shifting cultivation, and in which wildlife resources are no longer available? This situation is becoming increasingly common in Africa, particularly in the more fertile areas and in the vicinity of towns.

The answer, briefly is that the fertility, foods and materials formerly supplied by the bush must be substituted by commercial means. All these things cost money, so that small holders must change over to cash cropping. When the bush and wildlife resources are no longer available, therefore, the rural populations must undergo a profound economic and ecological transformation or suffer considerable hardships. It is fair to say that in many parts of Africa and the Third World generally, the transformation is as yet only partially complete, and hardship due to shortages of animal protein, building materials and fuel wood are already evident.

The point we wish to emphasize here is that the problem of the use of wildlife resources is not caused by the presence of conservation areas. It is caused by the process of development in these cases where development has failed to provide a substitute for wildlife resources and where development has so modified the environment that legal protection of samples of

the natural communities (in the form of conservation areas) has become necessary. In these cases, the opening up of conservation areas to uncontrolled exploitation is not the solution; it may provide temporary relief of local shortages, but the final result will be the same shortages without the benefits that conservation areas can supply.

The problem is that development is incomplete; it is not yet self-sustaining. The problem will ultimately only be solved in the developed areas by completion of the transformation of developed agriculture to a self-sustaining system. The ultimate solution to the problem of the use of wildlife resources in conservation areas is the transformation to self-sustaining land use in the developed areas so that rural communities no longer rely on wildlife resources. What we have to do now is to consider means by which the conservation areas can survive the transition period, while demands on their wildlife resources are still intense. The situation in Malawi is treated as a case study.

4. ILLEGAL ACTIVITY IN THE CONSERVATION AREAS IN MALAWI:

Malawi has a very high human density by African standards, so that relatively little remains in the way of large wildlife resources outside the conservation areas. Apart from limited extraction of timber and firewood from forest reserves, there is no legal provision for the use of wildlife resources in protected areas; so that these activities can for the moment be equated with illegal activities in the national parks, game reserves and forest reserves. (Fishing outside protected areas is the exception which is not considered in this section).

By its nature, illegal activity is difficult to assess quantitatively, and few attempts to do so have been made, in Malawi or elsewhere. Probably the most detailed study of this kind in Africa is the study of the hunters of the Luangwa Valley Bisa (Zambia) by Marks (1976). Comparisons of illegal activity between different areas are, therefore, difficult and largely subjective.

However, the wildlife Research Unit of the Malawi Department of National Parks and Wildlife has introduced a system of obtaining a quantitative index of the rates of illegal activity, based on a catch per effort analysis of game scout patrol reports (see Chapter 22). This method allows comparison of the rates of illegal activity between areas and time periods (i.e., seasons, years, etc.) The basic data for Kasungu National Park are shown in Chapter 22.

In assessing the size of the problem, we have to ask two questions:

Firstly, what impact does illegal activity have upon the national park? and

Secondly, what contribution does illegal activity (i.e., use of wildlife resources) make to the economy of the rural people living near the national park?

The first question is relatively easy to answer: In terms of its effect on the vegetation and the environment generally, the impact of illegal activity on the national park is very slight at its present level.

This is in spite of the fact that the rate of minor offenses increased significantly between 1977 and 1980, particularly as a result of incursions and tree felling related to the harvesting of the abundant tree caterpillar crops of the wet years 1979-1980.   However, with the drier years of 1981 and 1982, the caterpillar crop has been small and this important form of use of wildlife resources has been correspondingly reduced.

There can be little doubt, however, that if law enforcement efforts were relaxed, the impact on the vegetation would rapidly assume significant proportions, as it has in many of the relatively uncontrolled forest reserves, through extraction of timber, building materials and firewood.

In terms of the impact of illegal activity on the large mammal populations, there can be no doubt that here the goals of conservation and management in the national park are significantly affected.   The large mammals are affected both through direct off-take by hunters, and most importantly through disturbances by hunters and other illegal entrants which denies to them considerable areas of potentially available habitat. Thus, not only are the populations reduced below the carrying capacity of the park, but the carrying capacity on the park, as a whole, is reduced. This situation is best illustrated in the case of elephant poaching which will be described later.

The second question (what contribution does illegal activity, i.e., the utilization of wildlife resources, make to the economy of the rural people living near the national park?) is much more difficult to answer. The question has already been discussed in general terms in Section 3. Here we will look at it specifically in relation to some of Malawi's National Parks and Game Reserves.

Firstly, it should be emphasized that the great majority of people arrested in the parks and reserves are resident within a few miles of their boundaries.   This means that, in general, wildlife resources are available to the relatively small segment of the whole population living near the parks and reserves.   Therefore, in national terms, the contribution of wildlife resources must be considered to be small.   In this respect, Malawi contrasts with more sparsely populated African countries such as Botswana, Zambia, Sudan, etc.

Within the segment of the population living near the parks and reserves, however, the contribution of wildlife resources is probably large and important.   Some idea of the scale of contribution can be gained from the studies of Stier (1972) and Marks (1976) carried out in Luangwa Valley, Zambia.   These studies indicate that use of wildlife resources converts what would otherwise be an inadequate diet and resource base into one of considerable nutritional affluence.   We may imagine, therefore, that residents near the parks and reserves enjoy a better standard of living than the average rural population excepting perhaps the fishing communities of the lakeshore.

Here the point should again be emphasized that most illegal activity and use of wildlife resources is carried out by subsistence communities, and should be regarded as a more or less necessary adjunct to that lifestyle. People engaged in the cash economy by contrast are noticeably less involved in the use of wildlife resources. This can clearly be seen in the following instances:

(i)   Kasungu National Park:

The great majority of illegal activity takes place in the northern half of the national park adjacent to the subsistence farming communities in the areas of subchiefs Chulu and Lukwa. Furthermore, the majority of arrests are people from these areas. The southern part of the park, by contrast, is bordered mainly by tobacco farms either in the form of the KFCTA Linyangwa Small Holder scheme, or in the form of large estates. Relatively little illegal activity occurs in this sector, and relatively few arrests are made from these communities. Predictably, however, the rate of involvement of these cash croppers in illegal activity increased sharply in 1980 and 1981; these were years of low tobacco prices when many tobacco farmers failed to cover their loans.

(ii)   Nkhotakota Game Reserve:

This game reserve lies on the lakeshore escarpment, and separates the subsistence communities of the Kasungu Plateau (to the west) from the fishing communities on the narrow strip of lakeshore plain (to the east). Illegal activity is concentrated in the western half of the reserve and is mainly attributable to subsistence farmers from the Kasungu plateau. The relatively affluent cash-involved communities of the lakeshore plain apparently feel little need to supplement their resource base by illegal use of wildlife resources.

(iii)   Lengwe National Park:

This national park, situated in the densely settled lower Shire valley abuts to the east on the major agro-industrial development of the Secoma sugar estate, which employs 7,000 laborers, who are relatively well paid and supplied with meals at least once per day. This community makes a relatively small contribution to illegal activity in the national park. Here most illegal activity appears to be due to the subsistence communities to the north and south of the park.

There are, however, some notable exceptions to this generalization, involving commercial poaching by salaried government employees. This takes us to the next section which considers illegal use of wildlife resources in its role as a component of the cash economy.

5.   COMMERCIAL POACHING WITH PARTICULAR REFERENCE TO ELEPHANT:

So far we have been considering the use of wildlife resources of an adjunct to subsistence agriculture. We now have to consider the use of wildlife resources on a commercial basis, that is, as a component of the cash economy. Again, since nearly all wildlife resources in Malawi (other than fish and crocodile) are confined to conservation areas, this form of

use may be equated with commercial poaching. Moreover, although a few cases have occurred of commercial poaching of smaller animals for the sale of meat, by far the most important form of commercial poaching in Malawi concerns poaching of elephant for the sale of meat and particularly, ivory.

The influence of illegal hunting on Malawi's elephant populations is fairly clearly defined. Malawi holds a total of only about 2,500 elephant in several parks and reserves, the largest population being of about 800-1000 in Kasungu National Park. In most of the areas in which they occur, elephant are subject to fairly heavy poaching as well as a significant level of shooting by the Department of National Parks and Wildlife in the interest of crop protection on reserve boundaries. In two areas at least (i.e., Kasungu National Park and Vwaza Marsh Game Reserve), which between them contain about half Malawi's elephants, the total recorded mortality of elephants for 1981 (i.e., poaching, crop protection, natural and unknown causes) was equal to or in excess of the estimated recruitment of their elephant populations (see Chapter 22). Both these populations are, therefore, probably declining. In the remaining elephant populations, the necessary figures are not available, but the situation is probably similar.

In Kasungu National Park, at least, the illegal hunting of elephants has had a number of other effects on the ecology and management of the park which must be rated as undesirable in relation to the conservation objectives of the area.

Firstly, the elephant population has been compressed into the south-east corner of the park, and now occupies only 25% of the park area, that is, less than half the area occupied in 1977.

Secondly, as a result of this compression, the elephant density is locally very high, with a consequent impact on the vegetation structure through breaking and coppicing of woodland and, hence, on the distribution of other animals (cf., Bell 1981b).

Thirdly, the compression of the elephant population against the south-eastern boundary of the park has caused a rapid increase in crop damage problems in this area, as well as a shift in the distribution of damage towards previously unaffected areas (see Chapter 26).

Finally, the elimination of the elephant from certain areas of the park has greatly reduced the value of those areas as tourist amenities, (Bell 1982a), leading to a marked reduction in tourist utilization in these areas.

The influence of elephant poaching on the rural economy is complicated by the fact that the illegal off-take from the comparatively small number of elephants in Malawi is swamped by the flow of illegal ivory coming from the much larger elephant populations in neighboring countries, particularly the Luangwa Valley in Zambia. However, the point to emphasize is that here a wildlife resource (ivory) is being used as a cash crop in order to obtain necessities that are not available from the bush. In particular, our information indicates that much of the traffic in ivory is intended specifically to obtain cash to buy fertilizer, that is, to assist in the transition from traditional, subsistence, shifting cultivation to stabilized cash

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cropping agriculture. In addition, it is clear that the primary reason for the great inflow of ivory to Malawi from neighboring countries is the relatively favorable state of Malawi's economic situation, the relative availability of consumer goods here, and the relative strength of Malawi's currency. Ivory is therefore being used as a medium of exchange in a nonsubsistence cash economy based on distribution of products from specialized sources.

The point we wish to emphasize is that the commercial traffic in ivory should, at least in theory, tend to reduce the need for "subsistence poaching" by providing the ready cash to raise the subsistence rural economy to a level of self-sustaining cash cropping; that is, to complete the transition to developed agriculture as outlined in Section 3 of this paper. There, we said that the only way to reduce the need for the (illegal) use of wildlife resources is to replace these resources with commercial products obtained with cash. The trade in ivory provides a means towards that end.

The question we now have to ask is: are there any means by which the commercial potential of the conservation areas can be exploited to provide a cash stimulus to the adjacent rural communities (intended to reduce their reliance on wildlife resources as an adjunct to subsistence agriculture) that do not conflict with the overall goals of the conservation areas? Clearly, elephant poaching in its present form does conflict with those goals. Can we provide any alternatives, or devise any modified form of wildlife utilization that can overcome these conflicts of interest?

6.   STANDARD METHODS OF WILDLIFE UTILIZATION:

We said in the introduction that the problem of reconciling the goals of conservation with the demands by rural populations for wildlife products is a difficult one, and that we do not profess to have found a solution. Our purpose here is to discuss the pros and cons of various possibilities.

The first requirement, clearly, is to define the goals of conservation. In Malawi, the primary objective of the national parks and game reserves is to preserve in perpetuity selected examples of the wildlife communities (including animals and plants) of the country. The second objective is to ensure through catchment conservation, the sustained productivity of developed land outside the conservation areas (see Chapter 33).

The key question we have to ask, now, is what level of commercial exploitation of the conservation areas is consistent with these conservation goals? This question is, of course, one of policy; it is what Bell (1983) has defined as an aesthetic decision, which must be made by reference to a value system and cannot be made purely by technical analysis. The answer must vary from area to area in relation to detailed objectives; in general, the amount of permissable exploitation is allocated on the basis of zoning (see Chapter 35). Suffice it to say that, in Malawi, the protected areas are broadly zoned according to their legal status, the forest reserves permitting most commercial exploitation, the national parks permitting least, and the game reserves in between. Within each area,

further zoning has been carried out in the master plan for each park or reserve (see Chapter 35).

Within the zoning framework, the amount of permissable commercial exploitation by tourism or utilization of wildlife resources may in some areas be very low, but is nowhere flatly prohibited on principle. In some zones, indeed, the master plan calls for off-take of wildlife resources (i.e., culling of large herbivores) in order to maintain the state of ecological community within specified limits (Bell 1981, Clarke 1983). The question of off-take of wildlife resources is, therefore, accepted in principle; the amount is regulated according to the objective and character of the zone.

We now come to the question of how to put the commercial exploitation of the protected areas to the use of the adjacent rural populations. We have to return to the basic argument of this paper, which is the way to relieve the pressure on the conservation areas, both in terms of land and wildlife resources, is to encourage the transition of the rural communities from subsistence cultivation to genuinely self-sustaining cash-involved land use. The priority areas are those adjacent to the protected areas, and the basic method must involve injections of cash into these priority rural areas. This is in fact a well worn cliche in conservation circles: "We must show the local people that they benefit directly from the conservation areas." Easy to say; difficult to do.

Essentially then, the question resolves itself into two aspects; firstly, the generation of revenue from the conservation areas, and secondly, the distribution of revenue to the priority rural areas. There are several ways in which this can be done:

a. **Conventional Tourism:**

This may be regarded as the standard method of generating revenue from conservation areas, and little need be said about it. However, it must be emphasized that financial self-sufficiency of conservation areas through conventional tourism depends on the easy accessibility of a large cash-involved leisure-oriented society, and that few countries in Africa other than South Africa (with the possible exception of Kenya) come anywhere near covering the costs of its conservation areas by this means (see Chapter 35). Tourism in Malawi is very limited and it must be ruled out, for the time being at least, as a realistic source of revenue. Further, it should be noted that the tourist industry is negatively influenced by illegal use of wildlife resources, as had clearly been shown in the case of the Kasungu elephant. If one now includes a proportion of the cost of law enforcement in the tourist industry balance sheet, the economics become still less favorable.

On the second aspect also, that of distribution of revenue to priority rural populations, conventional tourism generally has a very poor record. As a rule, no revenue is returned directly to local rural areas, the majority being garnered by urban-based tour operators and the remainder disappearing into government central revenue to be reallocated according to a different priority system. There are, of course, several notable exceptions to this generalization, particularly in the sharing of tourist

revenue with the Masai county council in the Amboseli area in Kenya (cf., Western 1976) and a similar arrangement over the Nsefu sector of the south Luangwa National Park, Zambia (cf., Carr 1979), to mention only two.

b.   Professional Hunting:

Professional hunting has several advantages over conventional tourism as a revenue earner in that it generates a relatively large income from a relatively small turnover on the basis of relatively minute capital investment in infrastructure. Furthermore, a relatively high proportion of the income accrues directly to the conservation authority in the form of license and concession area fees. Such revenue is then potentially available for direct reallocation to rural areas if government machinery permits. The advantage of professional hunting as a form of land use and the ease with which revenue can be directed towards investment in rural areas has been most clearly demonstrated in Zimbabwe, and has been forcefully argued by Anderson (1983) in relation to the South African homelands.

The first disadvantage of professional hunting is that the scale of the industry and, hence, earned revenue depends heavily on local ecological conditions. Many of the conservation areas that are subject to heavy pressures from rural populations are in relatively unproductive areas, where hunting quotas would necessarily be low, even when not in competition with significant illegal off-takes. This is the situation in most of Malawi's conservation areas (cf., Bell and Mphande 1980). The economic equations from professional hunting in the relatively productive hunting areas of Kenya, Zambia and Zimbabwe cannot be applied to the relatively unproductive areas elsewhere.

A second disadvantage of professional hunting in parts of Africa is believed to be the negative public relations reaction of the rural communities to the prospect of wealthy foreigners being permitted to hunt in their own traditional, but now forbidden hunting grounds. It must be emphasized that the reality of this disadvantage is largely speculative; the public relations reaction is hard to assess, and few attempts have been made to do so. However, Lewis (unpublished data) obtained opinion data indicating that safari hunting in the Luangwa Valley, Zambia, is very unpopular with local residents. While McShane (1984) showed that the index of illegal activity in Vwaza Marsh Game Reserves, Malawi, increased at the time of an experimental safari hunt in 1983.

The third disadvantage to professional hunting is that it operates in direct competition with illegal off-take. The heavier the poaching, the lower the sustainable quota to professional hunting (Bell and Mphande 1980). Tipping the balance of the sustainable quota in favor of professional hunting depends on the perception of the rural population that they receive greater benefits via reallocated revenues from professional hunting than they do from poaching. The conservation authorities in Zimbabwe (cf., Cumming, pers. comm.) argue that the balance is in favor of professional hunting, and that its institution has led to a significant reduction of illegal hunting. In many other areas in Africa, this outcome is not so clear. Here, the existence of a sustainable professional hunting quota depends on a major law enforcement effort aimed at cutting out the

competitive illegal off-take. If the cost of this law enforcement effort is included on the balance sheet of the professional hunting industry, it is highly unlikely that many would be found to be economically viable.

In Malawi, conservation authorities have been sensitive to the possibility of a negative public relations reaction to professional hunting in their conservation areas from several of which the inhabitants have only recently been evicted and who feel a lively interest in events in those areas. In addition, most of the conservation areas concerned are relatively unproductive, and sustainable off-take quotas are low, while illegal off-take of some species is already thought to exceed sustainable yields. Ecologically viable professional hunting would therefore depend on an effective law enforcement effort, which would render the enterprise economically inviable overall. For these reasons, conservation authorities in Malawi have to date decided against professional hunting as a preferred form of land use. However, the question is under review.

c.   **Culling:**

Direct culling of wildlife populations by the conservation authority has some of the advantages of professional hunting, particularly that the system can be operated without the massive capital investment, dependence on international conditions and tourist pollution inseparable from conventional tourism. It also has the advantage that the public relations reaction among rural population is usually favorable as a result of the sale of cheap meat.

The major disadvantage associated with culling is organizational and economic. Most culling schemes require a significant financial outlay in staff salaries, transport, equipment and product preparation procedures as well as a considerable organizational capability. All the costs are exaggerated by the perceived obligation to equal the meat hygiene standards of the livestock processing industry. For these reasons, the economics of culling of most wildlife species, where the major product is meat for rural populations, are sometimes marginal and sometimes require subsidization (see Chapter 18 and 19).

A second disadvantage of culling, as with professional hunting, is that the off-take and hence the revenue, if any, is dependent on ecological conditions. Once again, many of the conservation areas under pressure are the relatively unproductive areas with the low sustainable yields for exploitation.

Finally, culling again shares the feature with the other forms of exploitation so far discussed, that it operates in direct competition to illegal off-take; the heavier the poaching, the lower the sustainable off-take to culling. If we now include law enforcement as a hidden cost of culling, necessary to ensure an economically viable off-take, then the overall balance sheet plunges irredeemably into the red.

What we have said so far about culling applies to the majority of species, where the main product is meat. In a few cases, however, the economic equation assumes a totally different aspect; that is in those cases where the wildlife species produces a byproduct with a special cash

value, as in elephant (ivory), rhino (horn), and leopard, Z ra colobus and crocodile (skin). Culling of such species can produce high profit margins even with relatively inefficient organization and high overheads. In these cases, culling operations can produce revenue that can be redirected to the stimulation of the transition to a self-sustaining cash economy in the priority rural areas.

d. Poaching:

Poaching is in many ways distinct from the forms of land use already discussed. Firstly, it is more or less universal in the conservation areas of Africa north of the Limpopo. Secondly, it is mainly carried out by local rural populations. Thirdly, the activity itself (apart from its control by law enforcement) involves the conservation authority in no outlay of money, staff or resources. Fourthly, it can be highly efficient in its full utilization of the animals killed; when it is not so, this is usually due to haste imposed by law enforcement activity. Fifthly, money and resources accrue directly to local rural populations except in those cases, significant in some areas, where commercial poaching is carried out by entrepreneurs based elsewhere. Sixthly, and finally, unlike all other forms of land use in conservation areas, the benefits to the rural population, in the short term, at least, are inversely related to the expenditure on law enforcement.

These features of poaching as a form of land use lead us on to the key question: why is poaching so successful and universally practiced, while organized culling schemes often are not? Why is poaching capable of an off-take of elephant (in, for example, the Luangwa Valley, Zambia) on the scale necessary to solve the overpopulation problem, when an interna- tionally financed culling scheme failed in the same endeavor?

The answer is quite straightforward: poaching uses appropriate technology while organized culling schemes generally do not. Poaching is carried out with very low overheads, by large numbers of skilled practitioners using relatively cheap equipment, and not requiring salaries, housing, mechanical transport, uniforms, night allowance, etc. Organized culling operations tend in the opposite direction, and the further they lean towards technical sophistication, the more likely they are to invite practical failure and financial disaster (see Chapter 18).

A factor that is often overlooked in the failure or organized culling schemes is the common demand for inappropriate meat hygiene standards. As soon as meat hygiene standards equivalent to those of the official live- stock industry are introduced, the technical problems and costs of culling immediately rise and block the avenue towards economic success of wildlife culling for meat (see Chapter 18). It must be emphasized that in most areas of Africa, these hygiene standards are inappropriate in that the potential market is usually already using the traditional bush-dried meat produced by poaching. The production of a more expensive hygienic product automatically excludes the priority rural population as a potential market and the product is redirected to a nonpriority sector of the community. The classic example of this redirection was the sale of frozen elephant meat from the cropping scheme in the Luangwa Valley as pet food in the urban areas.

We can now answer the question, why is poaching so widespread and hard to eradicate? It is because poaching is successful in that it provides real benefits in money and resources to those that carry it out, and it does so because of the skills of the practitioners, their use of appropriate technology, and their consequent low overhead costs. Finally, it should be emphasized that, in many areas, including rural Malawi, hunters occupy an important and recognized position in rural society (cf., Marks 1976), and in carrying out their profession, fulfill a respected cultural role.

The major disadvantage of poaching as a form of land use is that it is hard to control, and frequently conflicts with the conservation goals for the area concerned. A further disadvantage is that, as a rule, the landlord or conservation authority derives no financial return from this form of land use.

For these reasons, one of the major activities in conservation areas is law enforcement, aimed at reducing, or eliminating, illegal activity. Law enforcement is expensive in money, staff and resources and characteristically preempts a high proportion of the funds available to conservation authorities.

7.   TRADITIONAL USE OF WILDLIFE RESOURCES AS A POSSIBLE SOLUTION:

We have now returned to the basic conflict, the conflict between the demand for wildlife resources by rural populations and the objectives of conservation defined by the conservation authorities. We have concluded that the solution must eventually involve replacement of wildlife resources by trade goods through sustainable economic development in the rural area and that this process should be assisted by cash injections derived from commercial exploitation of the conservation areas. However, we have concluded that the three conventional forms of exploitation, i.e., tourism, professional hunting and culling, have, at least in Malawi's conditions, severe limitations in this respect. Is there then any solution to the conflict?

The suggestion we are about to put forward is not new; it formed the original concept of the Galana Game Management in Kenya in the late 1950s, (Parker and Amin 1983), and it has been suggested and tried in various forms in other contexts.

The suggestion is that poaching should be recognized and made use of as a legitimate form of land use. However, our suggestion differs somewhat from previous forms of the proposal in that we would like to encourage commercial poaching for high cash value products (particularly, ivory) at the expense of subsistence poaching and resources gathering. The objective would be to allow the commercial poaching to provide the cash injection into the priority rural areas in order to assist the transition to sustainable and self-contained cash-oriented agriculture, that is, the situation in which the requirement for wildlife resources is reduced. Subsistence poaching should be discouraged by an intensified law enforce-ment effort, which would also assist in the control of commercial poaching. Here the objectives would be to regulate the numbers, species and

distributions of the animals killed, according to the management plan of the protected area concerned.

How is all this going to be achieved? Is this merely the pipe dream of liberal conservationists, depending on the phantom of a mutually acceptable conservation ethic nurtured between the conservation authority and the rural people? Perhaps, this is what we want to find out.

The key to our proposal is that the conservation authority should insert itself into the commercial poaching system as a buyer for poaching products, particularly ivory. The long-term objective would be for the conservation authority to become the major buyer, thereby controlling the flow and hence elephant off-take to suit its management requirements in the conservation areas. This would perhaps be difficult, but our experience indicates that it would not be impossible. In the initial stages at least, the exercise might have to be clandestine, operating through middlemen not recognized by the poaching community as government controlled, or thought by them to be agents of corrupt officials.

The eventual object of the department would be to establish itself as the principal marketing agent for wildlife products, initially ivory, but also skins and other trophies and such meat as is not used locally. The difference between prices paid to the hunters and the resale price would be open to negotiation, but should be large enough to cover the department's costs and provide some revenue for the law enforcement effort which would continue. In fact, the department would be in a strong bargaining position because of the difficulties of the hunter in obtaining a better price elsewhere with the prevailing law enforcement effort.

Revenue would, thus, be injected directly to the priority rural sector through the buying price of the ivory. At the same time the rural community would obtain the bonus of the meat from the elephant killed, although it must be emphasized that the long-term strategy is to stimulate involvement in the cash economy and reduce reliance on bush products. Meanwhile, the conservation authority would be earning revenue from the resale of ivory. This revenue would then be available to subsidize further law enforcement effort.

In this context, we recognize that conventional law enforcement by field patrols will always be necessary if only to control subsistence poaching. However, particularly in relation to commercial poaching, by far the most cost-effective method is the use of informers in investigative activities outside the conservation areas. This method is naturally related to the ivory buying system that we have proposed in that the department controlled middlemen actually buying the ivory would be ideally placed to act as informers. They would undoubtedly be in a position to identify major alternative ivory outlets (i.e., genuinely illegal buyers), who could then be removed from the market by arrest. The department controlled buyers would then have two significant advantages over alternative buyers; firstly, since a high-profit legal resale would be assured they would be in a position to offer better prices, and secondly, the competition would be discouraged by informer-directed law enforcement. Given these advantages, it should be possible for the conservation authority to gain a high level of control over the ivory market. This

would then be the stage at which the conservation authority could begin to assert its control over the amount and distribution of elephant poaching in order to fulfill its management objectives. An example would be the maintenance of a low density of elephants in the northern part of Kasungu National Park in the interests of maintaining habitat diversity, by means of a controlled off-take in that northern area (cf., Bell 1981b).

Although many difficulties in operating such a scheme may be envisaged, we consider the potential advantages to be so many as to warrant its serious consideration and trial. The advantages are:

(i) Priority rural populations would derive direct financial benefits from wildlife, of the sort that would assist them to become independent of the use of wildlife resources on a subsistence basis. In the long run this form of commercial wildlife utilization is seen as reducing the scale of conflict between the demand for wildlife resources and the interests of conservation.

(ii) The investment required of the conservation authority would be minimal.

(iii) The conservation authority would earn revenue from the resale of ivory, which could then be reinvested in law enforcement and other forms of management.

(iv) In the initial stages, the conservation authority law enforcement capability would be greatly enhanced by regular access to reliable information in illegal activity, the information being derived from the controlled buyers. This should allow the overall illegal off-take to be reduced and the products to be channeled through the controlled buyers.

(v) In the long run, the system should allow the conservation authority to control the off-take in terms of numbers and distribution in accordance with its management requirements. In particular, in large elephant population areas, such as the Luangwa Valley, Zambia, Ruaha National Park, Tanzania, the Selous Game Reserve, Tanzania, or Tsavo National Park, Kenya, poaching could achieve (and in several cases has achieved) a successful population reduction, through the use of appropriate technology, where organized culling programs have been expensive failures.

(vi) Finally, (and in many ways we consider this to be the most important advantage of all) the system proposed here has the feature that the benefits accruing to the priority rural populations do so as a result of their own efforts, their own skills and through their own cultural institutions. The culturally destructive aspects characteristic of aid handouts are avoided and the commercial use of wildlife resources is fully integrated into the developing rural economy.

7. CONCLUSIONS:

This paper discusses the problem of the conflict between the demand for wildlife resources by rural populations on the one hand, and the objectives of conservation as defined by conservation authorities, on the other. We have concluded that the solution must involve the completion of the transition of subsistence rural economies to self-sustaining cash involved economies, so that the commodities (i.e., protein, building materials, fuel wood, etc.) that are now obtained illegally from conservation areas, may be substituted by trade goods obtained commercially. We have concluded that this must be done by encouraging involvement in the cash economy, for example, through the use of fertilizer to allow stabilization of a productive agricultural system, and that this involvement may be assisted by cash injections into priority rural areas derived from commercial exploitation of the conservation areas.

The various conventional methods of commercial exploitation of the conservation areas have been discussed; that is, tourism, professional hunting and culling. We have concluded that, in Malawi's conditions at least, the financial return, from which cash injections to priority rural areas would be derived, would be limited. Furthermore, considerable organization problems are involved which may be beyond the resources of some developing countries. Finally, it is emphasized that all these forms of exploitation are in competition with illegal utilization, and that the heavier the illegal off-take, the lower the revenue to be derived from the legal method. This carries the implication that the economic viability of legal exploitation depends on an intensified law enforcement effort. Once we include the large but hidden cost of law enforcement into the accounts ledger of legal exploitation, we conclude that most such forms of land use cease being economically viable.

Finally, we consider poaching itself as a legitimate form of land use. We emphasize that the widespread success of poaching (in contrast to the frequent failure of cropping schemes) is due to the skills of the practitioners, their use of appropriate technology and their low overhead costs. We go on to consider how these features may be harnessed to the service of conservation.

The key to the system we discuss is that the conservation authority should insert itself into the flow of commercial poaching products (particularly ivory) as a major buyer. Revenue would thus be directed immediately to the priority rural areas through ivory sales, while the conservation authority would earn revenue through resale on the international market. At the same time, information would be derived on the illegal trade which would assist law enforcement and so reduce the illegal off-take and channel the traffic through the department-controlled buyers. The eventual objective would be to dominate the ivory market (and that of other valuable wildlife products) in order to control off-take in relation to specirs, numbers and distributions. In this way, the management objectives of the conservation authority (in terms of population control, etc.) would be carried out effectively and at no cost to the conservation authority, by poachers, who have in several areas shown themselves uniquely qualified to do so. Finally, it is to be hoped that the cash injections to the priority rural areas would assist them towards self-sustained economic

development and so reduce their reliance on the exploitation of wildlife resources.

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CHAPTER 20

MONITORING OF ILLEGAL ACTIVITY AND LAW ENFORCEMENT IN AFRICAN CONSERVATION AREAS

BY

R.H.V. BELL

1.   INTRODUCTION:

This paper describes a method for monitoring illegal activity and law enforcement developed by the Wildlife Research Unit for use in the national parks and game reserves in Malawi, and it suggests guidelines for the use of the method in other African conservation areas.   The method described here is applicable to areas in which most illegal activity and anti-poaching work are carried out in the bush on foot.

The method consists of three basic elements, as follows:

a.   Recording of law enforcement effort by area and time units (i.e., in patrol days per 100 km^2 per month);

b.   Recording of all signs of illegal activity encountered by area and time unit according to standardized categories (i.e., gunshots heard per 100 km^2 per month); and

c.   Derivation of an index of encounter rates of illegal activity per unit of law enforcement effort by area and time units (i.e., gunshots heard per patrol day per 100 km^2 per month).

The index of encounter rates of illegal activity derived in this way is the equivalent of the "catch per effort" indices used in fisheries and the management of other fugitive resources. As in fisheries, the index can be used to provide an index of the population size (i.e., the amount of illegal activity per unit area and unit time), and whether the fishing effort (law enforcement effort) is affecting the population (amount of illegal activity).

In this way, it is possible to determine which areas and seasons are most affected by which kinds of illegal activity; whether the rate of illegal activity is changing with time; and whether the law enforcement effort is effective.   Law enforcement effort can be directed towards priority areas, and the effectiveness of different law enforcement methods compared. Finally, as in fishing, analysis of catch-per-effort data can be used to determine the optimum fishing effort, so the index of illegal activity rate can be used to determine the required level of law enforcement effort to reduce illegal activity to specified levels; unlike fisheries, however, it is usually the intention of law enforcement agencies to "overfish" the populations of illegal activity.

2.   THE BASIC ASSUMPTIONS:

The method of monitoring illegal activity described in this paper is based on two assumptions:

The first assumption is that the game scout's patrol reports are reliable accounts of their activities, not so much in terms of technical precision as in terms of being true reports of events as the scouts saw them.   The game scouts are subjected to a variety of influences which may motivate them to modify the facts in the reports.   This tendency must always be borne in mind and checked wherever possible.   However, our experience is that, in general, game scouts' reports are highly reliable in

this respect, and that given adequate training and supervision, game scout's patrol reports can be a valuable source of information on a range of topics including illegal activity.

The second assumption of the method is that, in any given set of conditions, there is some constant relationship between the actual quantity of illegal activity and the rate of encounter per unit effort. If the rate of encounter per unit effort changes, it means one of two things: either the actual quantity of illegal activity has changed, or the conditions have changed, or both.

This is, of course, the assumption underlying all quantitative index techniques. In favorable conditions, the method described here resembles the standard forms of strip censusing, such as the King census method, etc., which can provide absolute estimates of numbers.

The basic assumption can be represented algebraically as follows:

$$C/E = K \times I$$

Where   C   =   the "catch," i.e., the number of encounters with illegal activity per unit area per unit time;

       E   =   the "effort," i.e., the index of patrolling effort per unit area per unit time;

       K   =   the "capture constant," which defines the relationship between catch per effort and the quantity of illegal activity per unit area per unit time; and

       I   =   the quantity of illegal activity per unit area per unit time. It should be noted that the quantity here should strictly be measured in the same way as animal occupance, that is, in numbers x time present, since many signs of illegal activity are of limited duration; for example, the quantity of poachers in an area should be given in man-days.

The equation should strictly refer to individual classes of illegal activity. For example, the capture constant, K, for gunshots, which can be heard over several miles, is obviously higher than for carcasses, which can only be seen at the range of a few yards. The equation should, therefore, be written:

$$C_i/E = K_i \times I_i$$

where the subscript refers to the ith class of illegal activity.

The analysis and monitoring method described in this paper provides an index of the quantity of illegal activity that, as in most index methods (cf., Caughley 1977) bears a complex relation to the actual quantity of illegal activity. The complex relationship is contained in the black box labelled K, and the accuracy of the conclusions that can be drawn from the index depends on the extent to which the contents of that box can be

identified and measured or at least standardized. The more the contents can be measured, the more the index approaches an absolute estimate of quantity of the sort derived from the variety of strip census techniques available.

We are fully aware of the limits of precision inherent in the method described here; the index of rates of illegal activity is admittedly crude. However, we are concerned to provide a simple practical method that can be used by existing conservation agencies, not an imaginary ideal method that could never be put into practice.

We would finally like to emphasize that the use of the monitoring system described here should not be allowed to obscure the primary object of patrols, which is to act as a deterrent for illegal activity, not to generate data for publications, etc. In deciding on the level of detail to be aimed at in the monitoring system, the practical aspects of an anti-poaching patrol must receive priority, and not be hampered by the need to adhere to strict sampling procedures.

3. MEASURING LAW ENFORCEMENT EFFORT:

a. The Alternatives:

The alternative measures of patrolling effort which we have tried are here listed in the order which will give an increasingly close estimate of actual amounts of illegal activity (or anything else), that is, that brings them progressively closer to the requirements of a strip census.

(i) A count of the number of times each grid square is entered by a patrol per unit time;

(ii) A count of the number of effective patrol days per unit area per unit time;

(iii) A count of the number of kilometers (or other distance units) patrolled per unit area per unit time; and

(iv) An estimate of the area surveyed by patrols per unit area per unit time.

b. Effective versus Noneffective Patrol Time:

In using any of these measures, the first step is to distinguish between effective patrol time and noneffective time. Field staff spend a high proportion of their time in activities that give little or no chance of encountering illegal activity; this time has to be clearly separated from effective patrol time in which encounters with illegal activity are relatively frequent. In our analyses, then, we have distinguished four classes of activity by patrol staff:

(i) **Base Time**: staff in their base camp (i.e., ranger post, game scout camp, etc.); very low frequency of encounter of illegal activity.

(ii) **Out Time**:   staff away from their base camp (but not on patrol), i.e., sick, on leave, collecting pay, rations, attending court, etc.; very low frequency of encounter of illegal activity.

(iii) **Placement Time**:   staff making movements to reach a patrol area but not as an effective patrol (i.e., travelling by vehicle or bicycle, on roads, paths, etc. or in patrol camp); low frequency of encounter of illegal activity.

(iv) **Effective Patrol Time**:   staff on effective patrol (i.e., on foot in the bush); high frequency of encounter of illegal activity.

The importance of this distinction is shown by the fact that, in Kasungu National Park in 1982, the game scouts averaged 40% of their days as effective patrol days on which they recorded 98% of all encounters with illegal activity (other than in investigative operations outside the park), while the remaining 54% of days accounted for 2% of all encounters.

In analyzing staff time, base time and out time are relatively easy to identify (from staff reports, etc.). More of a problem arises, however, in distinguishing placement time from effective patrol time.

Effective patrol time is defined as time spent on foot in the field, not on a motorable road (even though the road may be temporarily impassable) and not on one of a set of named footpaths.

c.   What is Patrol?

The next step is to define what is meant by a patrol. Our definition is simply that a patrol is made up of a group of scouts, etc., whose members are in contact with each other as they move and who share information on a short-term (minute to minute) basis. It is necessary to specify how many men are in the group and whether they travel in line abreast, single file or any other configuration. In Malawi, patrols normally consist of between three to seven men walking in line abreast or single file; in these cases the patrol is counted as a single unit and no correction factor is added to weight the effort index in relation to the number of men in patrol.

d.   Visits to Grid Squares as a Measure of Patrolling Effort:

The simplest measure of patrolling effort is the number of visits by patrols to each unit area of the park, reserve, etc. Most conservation areas can easily be divided up into units, either on a simple grid basis, or into landscape units or vegetation types. In this paper, we will talk about grid squares for convenience, but the units of area might just as well be other kinds of units of different shapes and sizes.

In Kasungu National Park and Nyika National Park, we use 5 x 5 km grid squares, of which there are 120 and 138 that cover the parks and surroundings respectively.

In the measure of patrolling effort described here, the route of each patrol is drawn on a map as accurately as possible (for methods, see Section 5). At the end of each time period, i.e., month, year, etc., the number of times each square has been visited by a patrol is counted and that number is used as the index of patrolling effort for the square. This method was used by the Research Officer (Nyika) in his analysis of illegal activity in the Nyika National Park for 1982 (Mwalukomo 1983). He found that squares are visited with the following frequencies:

TABLE 1

NUMBER OF 5 X 5 SQUARE WITH FREQUENCY OF PATROL VISITS PER YEAR

Number of Visits Per Year	Number of Squares Visited at this Frequency	Percent of Squares
0	19	13.8
1 - 4	82	59.4
5 - 10	30	21.4
11 - 15	4	2.9
16 - 20	3	2.2
20 +	0	0.0
TOTAL	138	100.0

The visit count as a measure of patrolling effort has the advantage that it is relatively quick and simple to use in that it does not involve estimating patrol distances. It has the major disadvantages, however, that it may give a very inaccurate and misleading measure of effort, for example, where a patrol route regularly cuts through the corner of a grid square. We feel that visit counting is an unsatisfactory method and should only be used where distance patrolled cannot be estimated.

e. **Effective Patrol Days as a Measure of Patrolling Effect:**

The effective patrol day is the simplest unit of patrolling effort. We define an effective patrol day as a day, at least half of which (i.e., six hours) is spent on effective patrol time. Using this measure, one simply counts the number of effective patrol days by each patrol group in the period in question (i.e., month, year, etc.).

This measure has the advantage that it is very quick and simple to use. However, it has two major disadvantages:

Firstly, the measure assumes that an effective patrol day represents a constant quantity of patrolling effort. This is, of course, not true and may vary widely according to conditions. It is desirable whenever possible to attempt to check on the distance, etc., moved by patrols in the field. Bell (1979) concluded that, in Kasungu National Park, an average effective patrol day consists of five hours of patrolling at 3 km/hr. giving 15 km of patrol. Kasungu National Park is relatively flat and walking relatively easy except at the height of the rains.

The second disadvantage is that this measure does not lend itself very easily to breakdown by area except for relatively large areas. For example, in Kasungu National Park, each patrol group, based at a particular camp, usually patrols a particular sector of the park. The number of effective patrol days by that patrol group gives an index of the patrolling effort for its sector, but not for smaller units of area.

We find the effective patrol day to be the most useful measure of patrolling effort for the first stage of analysis, comparing years and comparing conservation areas with each other. For more detailed analysis by area, it is necessary to use one of the other measures of effort.

f.   Distance Marched as a Measure of Patrolling Effort:

To use this measure, the patrol route needs to be drawn accurately on a map and measured. The distance patrolled in each grid square is added to the patrolling effort index for that square for the period (i.e., month, year) in question. This method has been used by Bell (1979) for Kasungu National Park, Bell and Mphande (1980) for Vwaza Marsh Game Reserve and Bell (1980 and 1981) for Nkhotakota Game Reserve.

In the case of Kasungu National Park, the unit of distance used was a 5 km "patrol segment"; in the other areas, the units were single kilometers. Of course, the two are directly interconvertible.

This method has the advantage that it gives a relatively accurate and easily standardized measure of patrolling effort which can be related to area units at many levels of scale from 1 x 1 km grid squares to whole conservation areas. It caters for the effect of terrain and vegetation on patrol speed and for delays and interruptions.

The method has the disadvantage that it requires a relatively high level of proficiency in navigation, reporting and data extraction, which may be beyond the capabilities of the average game scout. Our view is that given adequate training, encouragement and supervision, patrol leaders can easily reach the required level of proficiency and that this level should be the standard for conservation organizations to aim for in their recruitment and training.

g.   Area Surveyed as a Measure of Patrolling Effort:

The use of this measure requires, first, a measure of distance patrolled as in the last paragraph, and second, an estimate of the mean detection radius for each class of illegal activity. In fact, by using this measure, the patrol is being used as a strip census technique with the

possibility of estimating absolute quantities of illegal activity (and other things, i.e., animals).

If this can be achieved, the advantages are very great. However, there are considerable problems. The first are the technical problems associated with strip census techniques (reviewed by Caughley 1979 and Collinson 1981, among others).

It is likely that biases and large sampling errors will be attached to the estimation of quantities, especially since each class of illegal activity, each vegetation type and each season would have to be treated separately. Then there are additional practical problems; to use a patrol as a strip census technique slows it down and distracts the leader from the primary purpose of law enforcement. We feel, therefore, that this method is inappropriate for normal patrols. However, if a research officer is working in the area, it would be appropriate for him to simulate patrols using this method in order to calibrate data derived from normal patrols.

h. Conclusions--Measures of Patrolling Effort:

Our conclusion is that there are two measures of patrolling effort of general value. These are:

(i)   The effective patrol day; this is a useful measure for the first stage of analysis, for making broad comparisons between large areas and long time periods. Efforts should be made to estimate the mean distance covered by an effective patrol day.

(ii)   The distance patrolled; this is the best all-purpose measure of patrolling effort, especially where comparisons are to be made between grid squares and months. Special efforts should be made in training and supervision to raise the proficiency of patrol leaders in the techniques of navigation and patrol reporting required for this measure.

The two other measures considered here, that of counting visits to grid squares and of estimating the area surveyed by patrols are of less general value, the first, because of the inherent limits to its precision as an index of effort, the second because of practical difficulties of achieving worthwhile precision and accuracy. The last technique, however, can be used by specialized units to calibrate results derived from the generally used measures.

4. RECORDING ILLEGAL ACTIVITY:

a. Introduction:

The basic procedure for recording illegal activity is, after each patrol, to draw the patrol route on a map, and to mark on the map and then count up, all signs of illegal activity encountered. It is important to develop standard methods of categorizing illegal activity and counting items.

b. **Dating of Illegal Activity:**

An important point is that, whenever a sign of illegal activity is encountered, an estimate should be made of the date when the activity took place. If, for example, an elephant carcass is found, the patrol leader should estimate as closely as possible the time since death.

He may be able to say "last week" or "two weeks ago," or he may only be able to say "several years ago." Any estimate is better than none at all. The reason for this is that we want to be able to derive an index of the amount of illegal activity that took place within a given time period.

c. **Classes of Illegal Activity and the Scoring System:**

This paragraph lists the classes of illegal activity as they are recorded in Malawi and indicates the information recorded on each and how the information is quantified or scored.

> **(i)** **Key Animals Killed:** This class contains data on key animals killed. Key animals are those of special interest for the area either because of the commercial value of their products or because of their rarity, etc.

Elephants and rhinos are good examples where they occur, while such species as giant sable, gorilla, chimpanzee, etc., might be considered key species in some areas. For key animals, as much information as possible is recorded on all carcasses found, whether due to poaching or natural mortality and whether discovered by patrols or other means. (For the analysis of mortality rates, of course, different means of discovery have to be treated separately). Data on key species are extracted separately and recorded in a ledger for each species with each individual carcass having a serial number assigned to it. The detail of the data recorded vary with species. For elephant, the following information should be recorded:

> **(1)** Date of death;
>
> **(2)** Method of discovery (i.e., patrol, aircraft, etc.; through direct sighting; through smelling carcass; through following vultures; through following poachers' tracks; through following up gunshots, etc.);
>
> **(3)** Cause of death (i.e., poaching, crop protection, licensed hunting, natural mortality, unknown);
>
> **(4)** Whether killed and recovered immediately or whether wounded and found dead;
>
> **(5)** Whether tusks present or absent;
>
> **(6)** If tusks absent, whether cut out or pulled out without cutting;
>
> **(7)** Age of elephant at death;

(8) Sex of elephant;

(9) Data on ivory if present (i.e., weight; total length; length tip-lip; circumference at base; circumference at lip);

(10) Whether ivory is marked by removal from skull (see p. 347);

(11) Whether meat has been removed from carcass;

(12) Whether meat drying rack is present;

(13) Whether pregnant or lactating;

(14) Body measurements, if possible;

(15) Location of death;

(16) Identity of killer if known or suspected; and

(17) Whether the carcass has been found by previous patrols.

In the case of key animals, the carcass should be marked in some way to indicate to later patrols that it has already been found. This can be done by issuing small metal tags to patrol leaders to attach with wire to the bones or by marking the bones with a panga or axe. The cranium is the best place for such marks. For the purpose of ageing and sexing, it is often necessary to recover the jaw. If this cannot be done by the patrol, it may be done by, say, a research or management team. If the jaw is recovered, it should be cleaned and stored and numbered with a metal tag stamped with the animal's serial number from the key species ledger.

Scoring of illegal activity with respect to key species is as follows:

(1) Each carcass killed by poachers during the time period in question (i.e., current year) scores 1;

(2) A drying rack scores 1;

(3) A poacher's camp scores 1; and

(4) A dependent calf dying as a result of its mother being killed by poachers scores 1.

(ii) **Other Animals Killed:** Other nonkey animals killed are recorded as follows:

(1) Date of death;

(2) Location of death;

(3) Method of detection;

(4) Cause of death; and

(5) Meat taken; drying rack present or absent.

(iii) **Gunshots Heard:** Each gunshot heard is scored as 1 (except for rapid bursts by semiautomatic or automatic weapons which may be recorded as bursts). Additional data recorded are: time of day, type of firearm and estimated location of shot (the last two points have proved difficult to judge accurately in the field. However, tests have shown that the radius of audibility of muzzleloading guns and heavy magazine rifles is about five miles in wooded country in day time, and about 1-2 miles for shotguns and light rifles) (Bell 1981).

(iv) **Armed and Unarmed Groups of Poachers Seen:** A group of poachers or illegal entrants to the area is scored as 1 irrespective of numbers, but numbers in the group are recorded for reference purposes. The reason for this is that the probability of encounter of a group of poachers by a patrol is thought to be relatively independent of group size. (This should, of course, be subjected to analysis as data become available). A group carrying one or more firearms is scored as an armed group; a group carrying no firearms is scored as an unarmed group. In Malawi, hunting with other weapons (i.e., bows, spears, etc.) is very rare; in areas where it is common, a separate category of, say, traditionally armed groups could be added.

(v) **Snares, Traps:** In Kasungu, snares and traps are not very commonly used, so that all snares and traps are lumped under one heading and scored as 1 each if in use during the current time period. In some areas it might be useful to distinguish between trap types, i.e., light snare, heavy snare, pitfall trap, gun trap, etc.

(vi) **Camps and Fireplaces:** Poacher's camps and fireplaces of the current period are scored as 1 each. Such camps, of course, vary from large permanent structures to small fireplaces. In some situations it might be necessary to subdivide this class.

(vii) **Drying Racks:** Drying racks for meat are scored as 1 each whether or not associated with a camp which is also scored.

(viii) **Footprints:** Footprints are arbitrarily scored as 1 per occasion seen, irrespective of the number of people in the group making the prints and irrespective of the distance followed.

(ix) **Fishing:** An additional score of 1 is given to a group of poachers seen fishing (the group already having scored 1 as

an unarmed group). A score of 1 is also given to a pool where signs of fishing are seen and to a set of fish traps (i.e., in a fishing weir) irrespective of the number of traps.

(x) **Tree Cutting**: Tree cutting is scored as 1 for each group of trees cut in a fairly small area (i.e., in a hectare); tree cutting may be subdivided into cutting for building poles, for firewood, for collecting caterpillars and other insects, for collecting honey, etc.

(xi) **Beehives**: As distinct from tree cutting for honey, are scored as 1 each.

(xii) **Grass Cutting**: Grass cutting, usually for thatching, is scored as 1 when confined to a small area (i.e., a hectare).

(xiii) **Cultivation**: is scored as 1 for each field opened in the conservation area.

(xiv) **Houses**: are scored as 1 each dwelling unit, not counting grain-stores, kitchens, etc.

(xv) **Livestock**: including dogs, is scored as 1 per group, irrespective of group or herd size, but group sizes are recorded for reference.

(xvi) **Collecting Vegetable Foods**: is scored as 1 if confined to a small area (i.e., hectare).

(xvii) **Digging**: i.e., for antbears is scored as 1 per excavation.

(xviii) **Motor Tracks**: are scored as 1 per set of tracks irrespective of length.

(xix) **Arrests**: Arrests are recorded as 1 for each individual in addition to the score for the group of poachers seen.

(xx) **Burning**: Burning does not receive a score on the grounds that it is too difficult to quantify and to attribute definitely to illegal activity. Burning is monitored separately by aerial survey.

d.   Scoring System and Summary:

To give an example of the scoring system, a situation in which a gunshot is heard and followed-up to find footprints leading to a dead elephant with a dead dependent calf with a camp and a drying rack, while a group is seen of six men with two muzzleloading guns of which four are arrested and one muzzleloader seized, is scored as follows:

1 x Gunshot

1 x Footprints

1 x Elephant killed (Fresh): Details recorded

1 x Dependent calf died (Fresh): Details recorded

1 x Poacher's camp

1 x Drying rack

1 x Armed group seen (6 people + 2 muzzleloaders)

1 x Arrests (+ 1 muzzleloader seized)

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11   Incidents + Muzzleloader Seized

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e.   Serious Offenses and Minor Offenses:

To assist in interpreting the data, the classes of illegal activity are divided into two groups, serious offenses and minor offenses.

Serious Offense are: Dead animals seen

Gunshots hear

Armed groups seen

Minor Offenses are all other classes of illegal activity.

The division is more or less arbitrary and can be modified to suit local conditions. In Malawi, the group of serious offenses corresponds closely to the activities of the relatively small numbers of serious hunters using firearms whose objectives are mainly elephant, rhino and buffalo. The minor offenses are far more numerous and are carried out by any member of the community including women and children; many aspects of the distribution and prevention of the two classes of offense are quite different.

5.   NAVIGATION, REPORT WRITING AND DATA EXTRACTION:

This section covers the practical details of getting the necessary information down on paper in report form during and after each patrol, and then extracting it so that it can be used for analysis.

a.   Navigation:

The first requirement of the system is that the patrol leader should be able to describe and record his patrol route with sufficient accuracy for the route to be drawn on a map (either by the patrol leader himself or by the analyzing officer), and its length measured. This, in turn,

requires that the patrol leader should be able to navigate accurately while in the field.

The problem here is that most field staff who are familiar with an area are able to find their way to any point within it with great accuracy; but many find difficulty in relating their position on the ground to a position on a map or air photo.

Our experience is that there are two solutions to this problem, each appropriate to a particular type of staff. Firstly, better educated staff (i.e., some game scouts, N.C.O.s and senior staff) can be trained to achieve an acceptable level of proficiency in conventional navigation using map, compass and various methods of estimating distance covered (see below).

Many less well-educated game scouts, however, never become comfortable or reliable with such techniques, although such men often make the most effective scouts in terms of field craft, ability to catch poachers and endurance. They also usually have excellent oral memories and narrative ability; this can be used as a substitute for formal navigating ability. These men are asked to write a detailed narrative account after each patrol, describing the route in as much detail as possible, and relating incidents of illegal activity, animal sightings, etc., to the route description. From such a narrative, it is usually possible to reconstruct the route with a good degree of accuracy on condition that the analyzing officer is himself thoroughly familiar with the area and that good maps exist with a high density of standardized place names.

b. Maps:

It is essential that high quality maps of the area be compiled. We recommend a scale of no more than 1:100,000. The maps should contain as much topographical detail as possible (often the areas are covered by high quality published survey maps), while in some areas it is useful to add conspicuous vegetation features, footpaths, water holes, etc. Such details can be located and transferred from air photos.

An important feature of the maps is place names. The map should incorporate as many place names as possible, which should be standardized among all field staff. It is very often the case that considerable confusion exists among field staff over place names, with the same points being given different names. This confusion must be ironed out through active work on the part of senior staff and N.C.O.s who must take part regularly and frequently in patrols (for this and many other reasons), and must annotate the maps as they go along and reach consensus with field staff of place names.

c. Measuring Distance Travelled and Dead Reckoning:

The ease of conventional navigation varies greatly between areas. In many of Malawi's conservation areas, navigation is quite difficult because of poor visibility due to the density of woody vegetation, and either complex topography (in escarpment areas such as Nkhotakota Game Reserve) or featureless topography in plateau areas (such as Kasungu National Park or

Vwaza Marsh Game Reserve). In such areas, navigation requires relatively careful dead reckoning, using compass bearings and an estimate of distance travelled. It is also useful to measure distance travelled so that information can be recorded on a distance unit basis (i.e., incidents, sightings, etc., recorded for each kilometer travelled).

Three methods of estimating distance travelled have been used: pedometers, timing, and counting paces:

(i)   Pedometers:

A variety of pedometers are available and some people find them reliable. Our experience, however, is that they are unreliable and misleading. Care has to be taken in carrying them so that they do not double-count paces, and they have to be calibrated for different conditions.

(ii)   Timing:

This is a fairly straightforward device, using the assumption that one is travelling at a relatively constant speed. Again, the method has to be calibrated for conditions: our experience is that, in good flat walking conditions, a kilometer is covered in about 12 minutes, while in hilly country without actual obstructions, a kilometer takes up to 20 minutes.

(iii)   Counting Paces:

This is our preferred method of estimating distance travelled since it is not liable to mechanical problems as are pedometers, and is not affected by interruptions and less influenced by terrain and vegetation than timing. Of course, the number of paces per kilometer has to be calibrated for each individual in different conditions. Usually in level country, a kilometer equals about 1,100 paces and in hilly country, up to about 1,400.

Whichever method of distance estimation is used, it should be checked wherever possible by reference to landmarks and corrected retrospectively, if necessary.

d.   Report Writing:

A written report is required after each patrol to be used as the source for data analysis and to act as a permanent record in case re-analysis is needed later.

The report writer should be nominated before the patrol starts so that he can pay attention to the necessary details of navigation, data recording, etc., and take notes when necessary. The report writer need not be the patrol leader, but should be trained in the details of the method and should be supplied with a list of instructions and report forms (see Chapter 23).

Some officers carrying out report analysis prefer to provide a detailed data form to be filled in by the patrol reporter so that data recording is standardized and extraction of data clarified.

Our preference, however, is that the report writer should write a narrative account of the patrol in as much detail as possible, relating all details of sightings and illegal incidents to the route description and time of day as closely as possible. The report writer is supplied with a list of required information but is encouraged to add whatever details he considers of interest. Such reports provide a relatively graphic account of the patrol with much uncategorized detail; a standardized form, on the other hand, provides less opportunity to correlate locations, times, etc. and encourages the writer to omit detail that does not conveniently fit the available categories.

In the case of staff using conventional navigation, of course, the report should be accompanied by a map marked with the route and incidents recorded.

e.   Debriefing:

It is useful to conduct debriefing interviews on a regular basis with patrol leaders and report writers in order to ensure that the patrol routes are correctly inferred from reports and that all necessary information on illegal activity is extracted. This is also the best way to train and update junior staff in report writing if the analyzing officer checks through the report in the writer's presence and comments on and corrects any omissions or errors. As a result of such interviews, junior staff also realize that the organization is taking a close interest in their activities; this raises morale and improves discipline.

f.   Data Extraction:

Data extraction should be carried out by a trained officer at N.C.O. or senior staff level who is thoroughly familiar with the aims and methods of the monitoring system. Conduct of the monitoring system should be considered a major and integral part of this officer's activities and should be combined with field work with active patrols in the bush to check performance, navigation, place names, etc., with training in navigation and report writing, and with the conduct of simulated patrols to estimate visibility profiles, etc.

Data extraction itself follows a standard format once the preceding steps of identifying classes of incident, recording of patrol routes, etc., have been standardized. Our system is as follows:

(i)   The patrol route is drawn on a map (usually at 1:100,000 scale); placement movements are distinguished from effective movements by color code. All the patrols for the time period of analysis (i.e., month, year, season) are entered on the same map.

(ii)   Two lists are compiled, one for incidents of illegal activity and one for animal sightings. All incidents and sightings are entered on the appropriate list with a serial number for each, under a heading for each patrol group and month.

(iii)   Each incident or sighting is entered on the map by means of
         its serial number and a color coding for class of activity
         and animal species.

         The details of any incident located on the map can quickly
         be obtained by reference to the appropriate serial number on
         the lists.

(iv)   The scores for classes of illegal activity, nights spent out
         by patrols, effective patrol days and placement days, as
         well as animal sightings are tabulated by patrol group and
         by month.

(v)   The grid for area analysis (i.e., 5 x 5 km grid) is overlaid
         over the map, and the total distance of effective and place-
         ment patrolling in each square is measured by means of a map
         measuring instrument.

(vi)   The score for each class of illegal activity and animal
         sighting is totalled for each grid square.

The basic data are now accessible for analysis as described in the
next section.   It should be noticed, for organizations with access to
microcomputers, that all of the above stages of data extraction and
processing (to be described) are ideally suited to computerization by means
of a digitizer.

6.   DATA ANALYSIS:

a.   Introduction:

The forms of analysis so far attempted fall under two main headings,
as follows:

(i)   Monitoring of the performance and activities of patrol
         groups by analysis of patrolling effort data; and

(ii)   Analysis of patterns and changes in illegal activity by
         means of catch per effort indices.

b.   Monitoring of the Performance of Patrol
Groups from Patrolling Effort Data:

Patrol effort data can be used to monitor patrol group performance in
several ways.

Firstly, the number of effective patrol days carried out per time
period (month, season, year) by each patrol group can be counted.
Secondly, the ratio of placement days can be calculated.   This ratio, of
course, is affected by the layout of the conservation area; centrally based
patrol groups tend to spend more time in placement than those in dispersed
camps.

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However, in a given set of conditions, the ratio of placement to effect days gives a good indication of the state of motivation, morale and discipline of the field force. The following table shows data from Kasungu National Park (from Bell 1983):

TABLE 2

	1977	1978	1979	1980	1981	1982
Number of Patrol Groups	4	4	4	4	4.4	5
Total Patrol Days	686	779	708	670	840	852
Mean Patrol Days per Group	172	195	177	167	191	170
Total Effective Days	475	582	480	435	665	704
Mean Effective Days per Group	119	145	120	109	151	141
Total Placement Days	211	197	228	235	175	148
Mean Placement Days per Group	53	49	57	59	38	30
Percent Placement	31%	25%	32%	35%	21%	17%
Elephants Killed by Poachers	16	15	26	35	55	29
Total Arrests	54	26	12	49	54	239
Firearm Captures	0	0	3	6	6	48

This table shows a decline in the performance of the field force from 1978 to 1980, with a decline in mean effective patrol days per group from 145 to 109 (25%) and an increase in mean placement days per group from 49 to 59 (20%) and an increase in the placement to effective ratio from 25% to 35%. This period corresponded to a period of weak and ineffective leadership and to a surge in poaching as a result of which the field force became demoralized. This can be seen by the increase in elephants killed by poachers from 15 in 1978 to 35 in 1980, coupled with the relatively low rate of arrests and capture of firearms (which gives a good index of the capture of serious hunters as opposed to minor offenders).

During 1981, the park came under new leadership: the patrol groups were reorganized into five instead of four groups and discipline was tightened up. During that year, the mean effective days per group increased from 109 to 151 and the mean placement days fell from 59 to 38. Although the poaching of elephants (which takes place mainly in the early

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months of the year) reached its peak in this year, with 55 reported killed, and no marked increase in arrests, the payoff came in the following year, 1982. In 1982, the mean effective days remained high and the mean place-ment days continued to fall to 17%.

At the same time, the number of arrests increased by 340% to a record figure of 239. That many of these were serious hunters is indicated by the rise in number of firearms captured (48). At the same time, the number of elephants killed by poachers fell to 29, and continued to fall in 1983 (8).

The value of the placement/effective ratio is that it is indicative of the state of mind of the field force. If a group is detailed for a five day patrol, but spends day one and day five solely in reaching and leaving the patrolling area by a 3-hour bicycle ride, the patrol is effectively reduced to three days. A highly motivated force will place itself and carry out an effective patrol on days one and five, thus, increasing its effective effort by 40%.

In assessing the time allocation of a field force, it is useful to establish a target figure of maximum practicable effective patrol time against which actual performance can be compared. This target figure will obviously vary considerably according to local conditions. In Kasungu National Park, it was calculated as follows for each patrol group per month:

 (i) A minimum of four rest days in base camp must be allocated;

 (ii) four days per month are allocated to visiting park headquarters to collect rations, pay and instructions;

 (iii) At an average placement/effective ratio of 20%, four days per month are spent in placement; and

 (iv) This leaves 18-19 effective patrol days per month or about 60% effective time.

In fact, it is very unusual to keep up an effective patrol rate at this level on a regular basis. In Kasungu National Park, the patrol groups usually maintain a rate of about 10-13 effective patrol days per month. We feel that it is optimistic to expect more than this on a regular basis, considering that the life of a game scout is generally arduous and often unrewarding.

c. Coverage of the Conservation Area by Patrols:

Patrolling effort data can be used to assess the patrol cover of a conservation area in two main ways:

Firstly, the grid square analysis of patrol visits or, preferably, patrol distance per grid square per unit game gives a useful broad index of the patrol coverage over a conservation area. For example, when patrol analysis began in Kasungu National Park in 1977, it was found that, of the 115 squares of 5 x 5 km covering the park area, 33 (29%) were not visited, while 55% of all patrolling effort was concentrated in 20 squares (17%).

As a result of feedback from the analysis, the patrol coverage was spread more evenly, but a gap of unpatrolled country remained in the park center, an area containing the park headquarters, most of the tourist roads and the principal concentration of elephant. On the basis of the patrol analysis, we predicted that this unpatrolled area would become the focal area for elephant poaching, and this is, in fact, what happened in 1980 and 1981. It was to cover this gap that the fifth patrol group was formed in 1981.

Second, the analysis of patrol coverage can be carried to a finer level of detail. The point here is to examine what a particular patrol effort index in an area actually means in terms of time and area under surveillance, and the probability of encounter between patrols and incidents of illegal activity.

The first point to emphasize is that in most African conservation areas, patrol coverage is very light. In Malawi, it is unusual for a 5 x 5 km grid square to receive more than 30 patrol visits per year. If one assumes a visit to represent five hours of active patrolling, this amounts to 3% coverage of daylight time. Most squares, in fact, receive less than 10 visits a year, representing less than 1% coverage of daylight time.

In order to estimate area surveyed, an estimate of the mean visibility profile is required. Bell (1979) estimated for Kasungu National Park, the mean visibility profile to be about 0.2 km (i.e., 200 m or 100 m on either side of the line of march), taking into account the difference in visibility between woodland and dambo. Using this figure in combination with an estimated mean patrolling distance per day of 15 km at 3 km per hour gives a mean area surveyed of 3 km^2 per day or 0.6 km^2 per hour, or 0.2 km, per km of travel. This means that, to survey completely a square of 25 km^2 would require 8.3 days, or 41.7 hours or 125 km of patrolling, assuming no repetition of routes. Again, assuming no route repetition, complete surveillance of an area of 2,500 km^2 (the area of Kasungu National Park) would require 830 patrol days, or 4,170 patrol hours of 12,500 km of patrolling. These figures are of importance when considering the probability of patrols encountering static items such as found ivory, elephant carcasses, poacher's camps, etc.

The last paragraph raises the question of route repetition by patrols, that is, the tendency of patrols to follow a limited number of familiar routes and footpaths, with the result that the actual coverage is less than optimum and that their movements become predictable and, hence, avoidable by poachers.

This tendency is particularly common in areas where patrol staff are inadequately supervised and in areas where movement is difficult because of thick vegetation or broken topography. The extent of route repetition was

examined by Bell (1979) for Kasungu National Park. It was found that in 1978, about 50% of all patrol movements were on routes used more than once, many being on routes used repeatedly. As a result, the 9,000 km patrolled, which potentially could have surveyed 1,800 km or 72% of the park area, in fact, surveyed about 925 km^2 or 37% of the park area.

d. Catch Per Effort: An Index of Quantity of Illegal Activity:

It is essential to relate the frequency of encounter of illegal activity to patrolling effort. Catch alone does not provide a valid index of the quantity of illegal activity, whereas catch per effort, C/E, does provide one. It is also important to realize that the catch per effort index in areas that receive no patrols is not zero (a figure which induces a false sense of security) but infinity (a figure which should at least arouse some curiosity).

The C/E index of the quantity of illegal activity can be used to make comparisons between areas and time periods. However, it should always be borne in mind, firstly, that the index depends both on the actual quantity of illegal activity and on the capture constant, K (see Section 2), which is determined by conditions of visibility, alertness of staff, etc.; and secondly, that the C/E index is the result of a sampling procedure and is, therefore, liable to sampling error or fluctuations due to chance.

(i) Comparison Between Conservation Areas:

The first stage of comparison is the broad comparison between relatively large areas, i.e., difference parks or game reserves by using the effective patrol days as the unit of effort:

TABLE 3

INCIDENTS PER EFFECTIVE PATROL DAY

AREA	TOTAL	SERIOUS	% SERIOUS
KASUNGU 1982	0.638	0.136	21.4%
VWAZA 1983 (Feb.-June)	1.768	0.106	11.6%
NYIKA 1982	1.500	0.165	11.0%

This table shows that Nyika National Park and Vwaza Marsh Game Reserve, which are very close to each other and have low staff densities, have similar indices of illegal activity and percentages of serious offenses.

Kasungu National Park, however, has a lower index of illegal activity, but a higher percentage of serious offenses related to the heavy elephant poaching still taking place in early 1982.

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(ii)   Comparison Within a Conservation Area:

The next stage is to make a broad comparison within a conservation area. The following table shows data for five different patrol groups in Kasungu National Park during 1982.

TABLE 4

ENCOUNTERS PER EFFECTIVE PATROL DAY

AREA	TOTAL	SERIOUS	% SERIOUS
NORTHWEST	0.61	0.12	19.4
NORTHEAST	0.74	0.10	13.5
CENTRAL	0.90	0.34	37.5
SOUTHEAST	0.45	0.10	21.1
SOUTHWEST	0.60	0.07	12.5
TOTAL	0.64	0.14	21.4

This table emphasizes the importance of the central patrol group, formed in 1981 to cover an area previously unpatrolled; this area not only had the highest overall index of illegal activity, but an unusually high proportion of serious offenses, specifically, killing of elephant. It also indicates a generally low level of illegal activity in the southeastern sector of the park, an area adjacent to a small holder tobacco project.

(iii)   Analysis by Grid Square:

Catch per effort has been analyzed by grid square in Kasungu National Park, Nyika National Park and Vwaza Marsh Game Reserve. As a general rule, the number of incidents of illegal activity encountered per square tends to increase with the amount of patrolling effort per square, indicating that a level of patrolling that acts as a clear deterrent has not yet been reached. However, there is a wide range of scatter of catch against effort. Briefly, the squares in Kasungu National Park have tended to fall into three clusters:

> (1)   Squares with relatively high values of C/E: these are squares with heavy illegal activity and not enough patrolling; they tend to be close to the boundaries of the park and near to centers of subsistence farming communities (as opposed to cash crop farms).

(2) Squares with intermediate values of C/E: these are the majority of squares; catch tends to increase with effort and there is no indication that patrolling is acting as a deterrent to illegal activity.

(3) Squares with relatively low values of C/E: these are squares in which C/E values are low while the level of effort is usually high. Most of these squares have either a permanent scout camp, a regularly used patrol camp, or a regularly used patrol route. The explanation for the low index of illegal activity in these squares may be, *either*, that when in or near a regularly used camp, scouts do not expect to encounter illegal activity and, therefore, stay on defined routes and, hence, miss signs of illegal activity; *or* that poachers know of and avoid regularly used camps and routes; this implies that such camps and routes act at least as local deterrents to illegal activity.

(iv)   Comparison of Illegal Activity Indices Between Years:

Comparison of illegal activity indices between years shows significant trends in some areas. Data from Kasungu National Park from 1977 to 1982 are shown in Table 5. This table makes a number of interesting points including:

(1) All illegal activity has shown a tendency to increase since 1977, the 1982 index for all offenses being more than double the 1977 index;

(2) The index for minor offenses has been the dominant factor, contributing in most years about 75% of all offenses; and

(3) The trend for serious offenses has been somewhat obscured by the fact that, during 1980 and 1981, most elephant poaching took place in the central part of the park where it was not recorded by patrols but by other means. However, the index for serious offenses shows a tendency to increase to a sharp peak in 1981 followed by a decrease in 1982 which is continuing in 1983.

TABLE 5

CATCH PER EFFORT: ILLEGAL INCIDENTS REPORTED
PER EFFECTIVE PATROL DAY

	1977	1978	1979	1980	1981	1982
Number of Effective Days	475	582	480	430	665	708
Elephants Killed*	0.019	0.017	0.046	0.032	0.032	0.027
Other Animals Killed	0.021	0.022	0.032	0.046	0.047	0.033
Gunshots Heard	0.027	0.027	0.052	0.030	0.108	0.065
Armed Groups Seen	0.010	0.017	0.010	0.014	0.042	0.011
All Serious Offenses	0.078	0.084	0.140	0.122	0.229	0.136
Unarmed Groups Seen	0.008	0.015	0.010	0.025	0.009	0.044
Snares, Traps, etc.	0.018	0.009	0.017	0.071	0.048	0.156
Camps	0.037	0.038	0.098	0.129	0,080	0.030
Footprints	0.086	0.098	0.208	0.225	0.191	0.141
Fishing	0.029	0.021	0.037	0.009	0.006	0.021
Tree Cutting	0.031	0.094	0.094	0.131	0.030	0.081
Grass Cutting	0	0	0	0	0	0.008
Cultivation/Houses	0.004	0.003	0	0.034	0.003	0.007
Livestock	0.004	0.003	0	0.003	0.003	0
Digging	0.010	0.009	0.012	0.018	0.008	0.013
Motor Tracks	0	0	0	0.003	0	0
All Minor Offenses	0.232	0.290	0.477	0.648	0.377	0.501
TOTAL	0.309	0.375	0.617	0.770	0.606	0.638

* The real trend in elephant hunting cannot be seen from this table since in 1980 and 1981, many elephants were killed in the Wangolo area which was not patrolled.

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(v)   Comparison Between Months:

Table 6 shows the indices of illegal activity for each month over three years in Kasungu National Park.

TABLE 6

MEAN INDICES OF TOTAL ILLEGAL ACTIVITY OF THREE YEARS
KASUNGU NATIONAL PARK

	J	F	M	A	M	J	J	A	S	O	N	D
C/E	0.38	0.72	0.39	0.44	0.57	0.62	0.57	0.45	0.42	0.40	0.29	0.51

No very clear pattern emerges from these figures except that the figures for the wet season and early dry season (December to July) tend to be as high or higher than those for the late dry season (August-November).

This contradicts the widely held view that the dry season is the prime period for illegal activity. Further evidence for the importance of the wet season as a period of illegal activity comes from:

a.   Vwaza Marsh Game Reserve, where Bell and Mphande (1980) found that 83% of all snares reported by game scouts in the three years 1976-1979 were collected in the wet season months November to April.

b.   The illegal killing of elephant in Kasungu National Park; of 80 elephants killed by poachers between 1977 and 1983 of which we have a good estimate of the date of death, the monthly distribution of death is as follows:

TABLE 7

ELEPHANTS KILLED

	J	F	M	A	M	J	J	A	S	O	N	D
No.	12	11	11	10	7	8	10	7	1	3	0	0
%	15	13.7	13.7	12.5	8.7	10.0	12.5	8.7	1.2	3.7	0	0

This table shows that elephant poaching is more or less absent in the latter months of the year but is at a peak in the wet season months January-April. The reasons for this pattern are not clear, although we have been informed of the need among subsistence communities to obtain food during the period of maximum food shortage prior to the harvest in April-May, as well as the demand for ivory at this time as a source of cash to buy fertilizer. It is also noticeable that the poaching of elephants falls off sharply in August when the grass begins to burn extensively, and resumes in January when the grass has grown up again. This may be related to the ease of hunting.

7. INTERPRETATION AND USE OF DATA ON ILLEGAL ACTIVITY:

a. Introduction:

The purpose of this section is to indicate some of the uses to which the data on illegal activity can be put, i.e.:

(i) Understanding the patterns and sociology of illegal activity;

(ii) Allocating law enforcement effort to counteract illegal activity; and

(iii) Examining various factors connected with the population dynamics and trophy trade of key species and products such as elephants and ivory and rhinos and rhino horn.

It must be emphasized that, to make these interpretations and to base decisions on them requires that the data from patrol reports be combined with data from other sources, particularly from investigations in settled areas, from standard research on animal populations and analyses of trade statistics.

b. The Sociology of Illegal Activity in Malawi:

The most important step in understanding and controlling illegal activity is for the law enforcement agency to realize that "Poaching" is not a faceless force of evil assailing the Garden of Eden, but that illegal activity in conservation areas is a set of economic activities carried out by rational people; that it is the result of a conflict of value systems between the conservation establishment and the rural communities.

Most illegal activity falls into two main categories, which we call minor offenses and serious offenses.

(i) Minor Offenses:

Minor offenses include the great majority of illegal activity. This class of activity is mainly concerned with collecting various materials and foods from the bush such as honey, small animals, birds and fish, vegetable foods, firewood, and building materials, as well as grazing of livestock. All these activities are integral parts of the subsistence rural economy which has existed for hundreds of years. This subsistence economy depends

not only on growing crops and herding livestock but on collecting additional foods and materials from relatively large areas of undeveloped land which may superficially appear to be unused. The only substitute for these materials is through cash purchase, so that in areas where population increase has brought most land into cultivation, considerable hardship may result. Collection of these materials is a relatively unspecialized activity so that any member of the community may be involved, including women and children. For these reasons, this class of illegal activity is difficult to influence through investigative activities in the communities, but must be controlled through patrolling in the field.

(ii) Serious offenses:

This class of activity is mainly concerned with the hunting of large animals with firearms. These are highly specialized activities and are carried out by a relatively small number of recognized hunters who have trained for many years under what can be called a guild system. Such hunters occupy a position of considerable influence and esteem in the community, providing as they do quantities of meat and cash from ivory, etc. to their extended families (Marks 1975). Because of their low numbers and relative ease of identification, these recognized hunters are very suitable targets for investigative activity.

The difference in origin of serious and minor offenses accounts for the fact that the indices for these classes of illegal activity behave to some extent independently of each other, although both tend to be associated with traditional subsistence communities rather than with cash crop agriculture, agricultural schemes and estates.

c. The Allocation of Law Enforcement Effort:

The first step in the allocation of law enforcement effort is to make a policy decision as to how much illegal activity is permissible.

On the basis of the analysis of catch per effort indices by grid square in Kasungu National Park, we conclude (see Section 6) that there is little evidence of deterrence at the levels of patrolling effort currently in use, except in squares with regular routes or camps, which experience at least 30 patrol segments per year. If we, therefore, take the figure of 30 patrol segments per grid square per year as a minimum for the park as a whole, we reach a requirement for 115 squares of 3450 patrol segments per year, which (Bell 1979) is the equivalent of 1725 effective patrol days per year. Taking (i.e., from Table 2) the figure of 120 effective patrol days per year as the capacity of a patrol group, this gives a requirement of 14.4 patrol groups in the park. Assuming a patrol group to consist of three game scouts and two porters, this gives a requirement of 43 game scouts and 29 porters for the park, giving an overall density of one game scout per 58 km^2 and one porter per 86 km^2. On this basis we have adopted an overall figure of one game scout per 50 km^2 and one porter per 80 km^2 of conservation area to be covered.

Of course it must be recognized that the requirement for staff density depends on a number of factors:

(i)   The first is the permissible level of off-take. In most areas there is a key species to the preservation of which law enforcement is geared. If it is a species such as elephant, the numbers and recruitment rates of which may be relatively high, then the absolute off-take may be relatively high (say 20 per year in Kasungu National Park, or 250 in the south Luangwa National Park). However, if the key species is rhinoceros or gorilla which may be present in very low numbers and the annual recruitment of which is only a few individuals per year, then the permissible off-take in most cases will be zero. To maintain such very low levels of off-take of a very attractive poaching target such as rhino requires relatively very high levels of patrolling effort and investigative activity.

(ii)   The second factor, implied above, is the demand for the species in question. If the species is very scarce but of little interest to poachers (as, for example, giraffe in the Luangwa Valley), then comparatively little effort is needed to protect it and then should be directed primarily at preventing habitat damage and disturbance. If the demand for the trophy is high, as with rhino, then law enforcement effort needs to be correspondingly high.

(iii)   The third factor is the penalty structure related to conservation offenses. Clearly a relationship exists between the level of deterrence, the probability of arrest and the penalty expected for the offense. It should be noted that in many countries, the penalties for poaching are less than the value of some of the products, particularly ivory and rhino horn, so that detection and arrest can be absorbed as an acceptable overhead cost. It is naturally desirable that penalties should be geared to the value of the product and to the conservation priority of the species from which it is derived.

(iv)   Related to staff density is the amount and type of equipment required. Our experience is that the use of sophisticated equipment, such as motorized transport, radios, aircraft and even tents, may have the effect of reducing rather than increasing the effectiveness of an antipoaching force, for two reasons:

        Firstly, their use induces a psychological reliance on them, so that when breakdowns occur, as they invariably do, the operation comes to a standstill; and

        Secondly, reliance on heavy equipment slows a field force down and reduces its flexibility and ability to operate in difficult terrain, often confining its activities to the vicinity of roads.

        If a force is to catch poachers, it must live and move like them; fast and light and flexible. This point is very

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important when one comes to review project proposals for upgrading law enforcement units; if the use of such equipment is proposed, the proposal must specify how the equipment is to be used to raise the effectiveness of the unit.

d. Population Dynamics and Trophy Trade of Key Species:

Data collected by the patrol monitoring system described here can assist in analyzing the population dynamics of key species and various aspects of the trade in their trophies. The following discussion will concentrate on elephants and ivory, but the same considerations apply to other key species such as rhinos, crocodile, etc. This discussion of elephant mortality and ivory movements stems from the concern of the WWF/IUCN African Elephant and Rhino Specialist Group with the effect of the international ivory trade on the living populations of elephants in Africa. The primary source is Parker's (1980) report on the ivory trade and the various discussions that have stemmed from it, for example, that of Bell (1982).

(i) Mortality:

The first requirement is to estimate the overall rate of mortality in as many areas as possible. Mortality data is normally difficult to obtain, but the patrol report system described here does offer a means of obtaining at least an index, and in certain circumstances an absolute estimate of mortality rates. In order to obtain an absolute estimate, the system must comply with the conditions of a strip census. This is the reason why one of the required items to be recorded is the means of detection of the carcass (i.e., visual sighting, by smell, by following footprints, vultures, gunshots, etc.) Each of these methods has a different mean detection range and carcasses detected in different ways should be treated as different classes of object (i.e., classes for which the capture constant K is different). This separation should considerably reduce the variance in the estimate of density of carcasses by the various strip census methods. A further condition for strip census methods with which it is difficult for patrols to comply is that of randomness of patrolling in relation to elephant carcasses; elephant tend to die near streams and dambos (Graham and Laws 1971, Bell, unpublished data) and patrols tend to be nonrandomly distributed in relation to drainage, following streams in flatter areas, avoiding them in hilly areas. Therefore, estimates of carcass density from patrol data have to be treated with caution and checked against other methods when possible.

(ii) Age and Sex:

It is important to classify mortality against age and sex. Sex of animals over about 15 years old can be determined both from the lower jaw and tusks, while age can be estimated from shoulder heights (on an intact carcass) or the lower jaw. A moderate estimate of age can be made from tusks (i.e., from weight and circumference at the lip or base). The tusks, of course, are always collected, if present; it is also useful where possible to collect and store the lower jaw for reference purposes. However, this raises logistical problems on normal patrols and it is useful to train

patrol leaders in the methods of determination of age and sex from lower jaws.

(iii)   Cause of Death:

The importance of this item is self-evident. In many cases, the cause of death is clear; in the case of many elephants killed by poachers, the tusks are cut out, and often the meat is removed and smoked leaving a characteristic drying frame. In the case of licensed hunting and crop protection shooting, the cause should be clear from the relevant reports. In all the above cases, killing by poaching, crop protection shooting, and licensed hunting, the tusks are normally cut out of the skull leaving the typical marks on the tusks which distinguish them from "found ivory."

TABLE 8

CHARACTERISTICS OF MARKED AND UNMARKED (FOUND) IVORY
FROM PARKER (1980)

MARKED IVORY

The presence of:

(i)	Any axe, knife of scrape marks however small;
(ii)	Any bone connective tissue adhering to the tusk, however small;
(iii)	Any blood stains;
(iv)	Any sign of burning without other signs of weathering.

UNMARKED IVORY

The absence of:

(i)	Axe, knife or scrape marks;
(ii)	Any bone or tissue;
(iii)	Blood stains.

The presence of:

(iv)	The characteristic greenish stain caused by rotting;
(v)	Hair line shakes or cracks in the butt of the tusk;
(vi)	Weathering;
(vii)	Burns and porcupines gnawing on otherwise unmarked tusk.

"Found ivory" is derived from that class of elephants that dies in the bush and is not immediately found by people, so that when found, the carcass has rotten and the tusks are loose and can be removed without cutting and are, therefore, unmarked. Such tusks can clearly be distinguished from

the marked ivory cut from the skull (see Parker 1980). "Found ivory" is derived from the following main forms of mortality. These are natural mortality and wounding by poachers, crop protection and licensed hunting. It is important to attempt to distinguish the relative contributions of the two forms of mortality if one is to understand the influence that man-induced mortality is having on the population. Distinguishing death from wounding from natural mortality is often very difficult, especially in the case of rotten carcasses or skeletons. Two approaches are possible:

Firstly, one can use metal detectors to try and locate bullets, arrow heads, etc. We ourselves have no experience of this technique, but we anticipate two kinds of problem. Firstly, bullets causing fatal wounds do not always lodge in the body, but may pass through and so not be found; secondly, in many areas, a high proportion of all live elephants carry projectiles in their bodies whose wounds have healed; carcasses from animals actually dying from natural mortality might, therefore, yield projectiles and be wrongly classified as dead from wounding.

The second approach is to compare the deaths from unknown causes with the deaths from known causes in terms of age and sex distribution, geographic location, etc. We find that when this is done, a high proportion of the unknown deaths matches the classes from known poaching and known crop protection shooting and can probably be attributed to wounding by these agencies; however, there are two types of "unknown" carcass which are overrepresented in this comparison; the first is of young elephant (i.e., under ten years old), which probably mainly represent natural mortality, in our case largely due to predation by lions; the second is of older elephant (i.e., over 30, but including animals up to 60 years old) many of them bulls. These may represent natural mortality of older animals, in the case of bulls, perhaps due to fighting between bulls which may be a more frequent source of mortality than generally realized (Hall-Martin, per. comm.)

Our conclusion from Kasungu National Park is that the great majority (perhaps 80% of "found ivory" from elephant over ten years old) is due to wounding rather than to natural mortality.

A further point of interest has recently emerged. In 1983 the recorded mortality from poaching was eight elephants compared to 29 in 1982 and 55 in 1981. This decline was paralleled by a decline in apparently natural mortality of juveniles assumed to be due to predation by lions, from 15 in 1981 to 12 in 1982 to seven in 1983. This suggests a causal relation between "natural" mortality of juveniles and poaching of adults. Of various possibilities, the most likely explanation seems to be that juveniles whose mothers are killed by poaching are more vulnerable to lion attack.

(iv)   The Finding Rate:

This is the proportion of all carcasses (and ivory) dying in the bush from natural mortality and wounding, that are found and recovered, either by legal agencies or by illegal collectors. The importance of the finding rate is that it allows the mortality from wounding and natural mortality to be estimated from the quantity of found (i.e., unmarked) ivory identified

in the major ivory trading centers (cf., Parker 1980, 1983).   If the
finding rate is low, then a small quantity of found ivory represents a
correspondingly large mortality of elephants, the majority of which are
never found.   This point has been discussed by Parker (1980) and Bell
(1982). It is here worth noting that one tusk from each form of mortality
represents a different number of elephant deaths, i.e.:

> 1 tusk from Mn (natural mortality) represents $1/(T \times F \times Kt)$
>   elephant deaths

> 1 tusk from Mw (wounding) represents $1/(T \times F)$
>   elephant deaths

> 1 tusk from Mk (direct killing) represents $1/T$
>   elephant deaths

> where T = Number of tusks per tusk bearing elephant (i.e.,
>   over two years old).

> Nt = Proportion of natural mortality leaving tusks (i.e.,
>   over two years old).

> F = Finding rate of ivory on offer in the field over its
>   total available life.

In order to estimate the finding rate, it is necessary to make an
estimate of the actual mortality of the elephant population in question,
either from an analysis of population dynamics or from a series of
estimates of numbers.   Against this estimate is compared the number of
carcasses found.   This gives the finding rate by the conservation agency.
The finding rate by poachers can be estimated by comparing the total
carcasses found (by the agency) from which the tusks had been pulled
without cutting and for which there was no sign of meat racks, etc. (this
is the class of carcasses due to wounding or natural mortality which had
subsequently been found by poachers), with the total carcasses found with
ivory in place (i.e., the class of carcasses due to wounding or natural
mortality which had not been found by poachers).   There can be no doubt
that the finding rate varies greatly from place to place.   In Kasungu
National Park, the finding rate by the Department of National Parks and
Wildlife is high, perhaps 80% or over.   Parker (1980) presents data from
Tsavo National Park suggesting a finding rate of 25%, although Parker
himself argues that the finding rate is often less than 10%, probably
incorrectly (see Bell 1982).

8.   CONCLUSIONS:

The purpose of this paper is to provide guidelines for a system for
monitoring law enforcement and illegal activity in Africa conservation
areas.   The system is based on the systematic use of patrol reports
produced by field staff.

Law enforcement is one of the major branches of wildlife management in African conservation areas. The monitoring system described here provides a means whereby the actual performance of this branch of management can be evaluated and, if necessary, modified or adjusted. Such forms of management are based on the assumption that certain techniques and methods are effective; the monitoring system described here provides a means by which these assumptions can be tested and, if necessary, replaced or improved.

This role as a means of evaluating the performance of a major branch of wildlife management should be seen in the wider context of the concept of adaptive management. This concept recognizes that every set of management is based on a set of theories which may or may not be correct.

Given the complexity of the systems being managed, it is probable that most of the theories, and therefore, practices based on them, are incorrect or at least require revision. Each act of management, therefore, should be designed as a test of the theories on which it is based. This requires adequate planning, recording and evaluation of the performance of each branch of management.

The monitoring system described in this paper is intended to fit just this role. It is regarded as an integral component of an agency operating by adaptive management in all its branches. The roles of research, management and monitoring are seen as parts of a continuous range of interests, not conflicting but interlocking. Equally, the techniques involved in the actual execution, the recording, the analysis and the evaluation of a particular branch of management are seen as part of a body of professional expertise that should be built into the agency, starting at the level of training curricula, reinforced by in-service training and formalized by the administrative structure (i.e., by the required forms of reporting, etc.)

We argue that only in this way will conservation agencies reach the level of professionalized self-correction that will allow them to conserve Africa's wildlife resources in an efficient and responsive manner.

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CHAPTER 21

INSTRUCTIONS FOR WRITING PATROL REPORTS

BY

R.H.V. BELL

1. The report writer should be nominated by the patrol leader before the start of the patrol. This need not be the patrol leader himself, but if the writer is not very familiar with the area, he should be assisted in describing the route and place names by other members of the patrol. In any case, all members of the patrol should assist the report writer whenever necessary. The patrol leader is responsible for ensuring that an accurate report is submitted.

2. The report writer should be provided with the following items before the patrol starts:

   Instructions for writing reports

   Notebook

   Pencil/ballpen

   Tape measure

   Number tags for elephant and rhino skulls

   Report forms for elephant and rhino carcasses

   Map

3. The report may be written in English, Chichewa or Chitumbuka, whichever language the writer finds most convenient.

4. The writer should take notes during the patrol of all matters of interest, including route taken, times, animal sightings and incidents of illegal activity. The writer should not wait until the end of the patrol to write down this information.

5. At the head of each patrol report, the following information should be recorded:

   a. Dates of patrol;

   b. General area patrolled;

   c. Names of all patrol members, including porters;

   d. Name of report writer; and

   e. Camp at which members usually live.

6. The report of each day of the patrol must be clearly headed by the date.

7. Always describe how the patrol moved, i.e., in line behind each other, or in line side by side, how far apart, etc. Always state how many were moving in the group and how many remained to guard the base, etc.

8. The times of events should always be indicated, either by means of a watch, or if one is not available, by estimating from the sun, etc. This refers to times of starting and ending patrols, sightings of animals, illegal incidents, etc.

9. It is very important to describe the route in as much detail as possible. Always state the name of any stream or river followed (if known), or any hill or other landmark passed. Always state which side of the stream was followed (i.e., north, east, south, west, etc.), and whether the patrol moved upstream or downstream. If moving in woodland, always state how far to the nearest stream. Always remember that the purpose of this part of the report is to allow senior staff to follow exactly the route of the patrol on a map.

10. When maps are available, check to see if the place names used in the report are found on the map. If they are not found, or if you think they are in the wrong place, write the name on the map where you think it ought to be. If in doubt, discuss it with other field staff and senior staff. It is very important to compile accurate maps with correct place names that everyone knows and agrees on.

11. Always describe the position of the patrol base or camp in as much detail as possible. If it is a regularly used base, describe it in such a way that senior staff can easily tell which camp you are referring to.

12. Always describe the position of any animal sighting or incident of illegal activity in as much detail as possible so that senior staff can find the place on the map. If you hear a gunshot, state both where the patrol was when the shot was heard *and* where you think the poachers were when shooting. Remember that guns cannot usually be heard over a distance greater than about 5 km.

13. **ANIMAL SIGHTINGS:**

    a. Write down all animals seen, giving species, total number of each group and whether any newborn young present. Mention sex if it is clearly visible but this is not very important.

    b. Describe the position of each group seen as accurately as possible.

    c. Indicate the time of day each group was seen.

    d. Always record sounds of any lion or leopard heard either by day or at night.

    e. Always record any sign of rhino, i.e., tracks or droppings. If a tape measure is available, measure the width of the footprint across the widest part of the two outside toes of any clear footprint found:
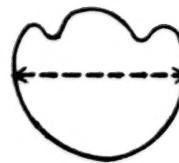
If you find any rhino droppings which are still in one piece, measure the circumference:

Always describe the location of any sign of rhino in as much detail as possible.

14. **SIGNS OF ILLEGAL ACTIVITY:**

a. Always record all signs of illegal activity in as much detail as possible. Record the location and the time of day of any sign was seen or heard.

b. Always make an estimate of the date when the illegal activity took place. For example, if you see footprints, state how old they are, i.e., the same day, two days old, two weeks old, etc. If you see a poacher's camp or a dead animal, try and estimate when the camp was last used and when the animal was killed. If you are not sure, say so but make a rough guess, i.e., last wet season, more than three years, etc.

c. Dead or wounded animals seen: this type of incident will be dealt with in detail in the next section.

d. **Gunshots:** record the time of day, the location of patrol when hearing the shot and the place or direction in which you think the poachers were when shooting. Say what type of gun you think it was.

e. **Groups of Poachers Seen: Record**

   (i)   Time of day and location of group seen;

   (ii)   What they were doing;

   (iii)   How you found them (i.e., by following gunshot, following footprints, hearing voices or axes, seeing them walking, etc.);

    (iv)   How many in the group;

    (v)   What weapons (i.e., guns, spears, axes, pangas, fishing rods, etc.) they were carrying;

    (vi)   Their names if known; and

    (vii)   What happened, where did they go? How many arrested? (see paragraph 16 below).

f.   <u>Snares and Traps</u>: Record

    (i)   Time of day and location found;

    (ii)   Type of snare or trap;

    (iii)   Number of snares or traps;

    (iv)   When the traps were prepared;

    (v)   Are they still in use;

    (vi)   Have they caught any animals? If so, give details; and

    (vii)   Any indication of who is the owner.

g.   <u>Poacher's Camps and Fireplaces</u>: Record

    (i)   Time of day and location found;

    (ii)   Type of camp or fireplace (i.e., with shelter, number of people using it, etc.);

    (iii)   When camp was built;

    (iv)   When camp was last used;

    (v)   Has camp been seen before by patrol;

    (vi)   Any signs of what users were doing (i.e., dead animals, ammunition, drying racks, fish bones, papers, etc.); and

    (vii)   Any indication of where users came from (i.e., Zambian items, matches, newspapers, etc.)

h.   **Drying Racks**:   Record

   (i)   Time of day and location found;

   (ii)   Type of drying rack (i.e., large for elephant, small for small animal, very small for fish, etc.);

   (iii)   When drying rack was built;

   (iv)   When drying rack was last used;

   (v)   Has it been seen before by patrols;

   (vi)   Has the rack been used; and

   (vii)   Any signs of type and number of animals killed.

i.   **Footprints**:   Record

   (i)   Time of day and location found;

   (ii)   Number of people making tracks; what kind (i.e., men, women, children);

   (iii)   Type of shoes used;

   (iv)   Direction of tracks;

   (v)   Special features, i.e., whether running, wounded, etc.;

   (vi)   When were footprints made;

   (vii)   How far were footprints followed; and

   (viii) What were the people doing who made the tracks.

j.   **Fishing**:   Record

   (i)   Any signs of fishing in rivers or pools;

   (ii)   Any fishing weirs or fences;

   (iii)   The number of traps in each weir or fence or alone;

   (iv)   Signs of fish or fishing in poacher's camps;

   (v)   Whether poachers seen are or have been fishing; and

   (vi)   The time of day and location of any of the above signs.

k. <u>Tree Cutting</u>: **Record**

(i)   The time of day and location seen;

(ii)   The type of tree cutting, i.e., for building poles, for firewood, for caterpillars, for string, for honey, for medicine, etc.;

(iii)   The time the cutting was done (i.e., fresh, two weeks, last year, etc.);

(iv)   How many trees cut (i.e., one, ten, hundreds, etc.);

(v)   What kinds of trees cut (i.e., brachystegia, mopane, etc.); and

(vi)   Any indication of who did the cutting.

l. <u>Beehives</u>: **Record**

(i)   Time and location found;

(ii)   Type of beehive;

(iii)   Whether occupied by bees;

(iv)   Whether still being visited by owner;

(v)   When was the hive put up; and

(vi)   Who is the owner.

m. <u>Grass Cutting</u>: **Record**

(i)   Time of day and location seen;

(ii)   How much cut;

(iii)   Purpose of cutting (i.e., thatching, etc.);

(iv)   Cut grass still there; and

(v)   When was the grass cut.

n. <u>Cultivation</u>: **Record**

(i)   Time of day and location found;

(ii)   Type of cultivation;

(iii)   Area of cultivation;

(iv)   When was garden opened, planted, harvested, etc.; and

(v)   Who opened the garden.

o.   <u>Houses</u>:   **Record**

   (i)   Time of day and location found;

  (ii)   Type of house;

 (iii)   How many houses and grain stores, etc.;

  (iv)   When were houses built;

   (v)   Are houses still occupied; if not, when were they left; and

  (vi)   Who built the houses and how many people lived there.

p.   <u>Livestock and Domestic Animals</u>:   **Record**

   (i)   Time of day and location found;

  (ii)   Type of animals (cattle, sheep, dogs, etc.);

 (iii)   How many animals;

  (iv)   What were they doing (i.e., grazing, drinking, hunting);

   (v)   Who is the owner; and

  (vi)   What action did you take.

q.   <u>Collecting Vegetable Foods</u>:   **Record**

   (i)   Time of day and location found;

  (ii)   Type of plant collected (i.e., chinaka, nthudza, etc.);

 (iii)   How much was collected;

  (iv)   When was the collecting done; and

   (v)   Who did the collecting.

r.   <u>Digging</u>:   **Record**

   (i)   Time of day and location found;

  (ii)   What type of digging (i.e., for antbear, pot clay, etc.);

 (iii)   How much digging;

  (iv)   When was digging done; and

   (v)   Who did the digging.

s.   **Wheel Tracks**:   **Record**

   (i)   Time of day and location seen;

   (ii)   Type of tracks (i.e. ox cart, bicycle, land rover, etc.);

   (iii)   How many sets of tracks;

   (iv)   When were the tracks made;

   (v)   What was vehicle doing;

   (vi)   Who is owner of vehicle; and

   (vii)   How far did you follow tracks.

t.   **Burning**:   **Record**

   (i)   Time of day and location found;

   (ii)   Is fire still burning;

   (iii)   When was fire started;

   (iv)   When did fire stop;

   (v)   How large an area was burnt;

   (vi)   Who started the fire; and

   (vii)   Where was fire started.

15.   **DEAD ANIMALS SEEN:**

a.   The following items must be recorded on *all dead* animals found.

   (i)   Date, time of day and location found;

   (ii)   Type of animal; species, age, sex;

   (iii)   How was the animal found (i.e., by seeing carcass, by smelling carcass, by seeing vultures, by following gunshot or footprints, etc.);

   (iv)   What was the cause of the death (i.e., poaching by gunshot, arrow, snare, etc., crop protection, killed by lions, unknown, etc.)? Give your reasons for what you say;

   (v)   When was the animal killed? Indicate the state of the carcass, i.e., fresh, rotten, bones with dry meat and skin, clean bones, old bones scattered apart, etc.;

   (vi)   Has the carcass been seen by other patrols;

(vii)   Has meat been taken by poachers; is there a drying rack;

(viii)   Identity of killer if known or suspected; and

(xi)   Any other item of interest.

b.   The following items must *also* be recorded on *all* dead *elephants* found: (A special form will ᵇe provided and should be filled in on the spot. If the carcass has not been recorded before, the form should be sent to PWO by the first available transport after the patrol returns to its base camp.)

(i)   Has carcass been found by a previous patrol (i.e., is a tag present or has the skull or lower jaw been marked with a panga or axe?);

(ii)   Serial number attached to the carcass. Small metal tags will be provided; these will be attached to the carcass, preferably to the skull. If a tag is already present, this number should be recorded and no new tag need be attached. If no tag is found. a new tag should be attached and its number recorded;

(iii) What type of mark made on the skull or lower jaw? If there is no mark present, a mark should be cut on the skull and lower jaw with a panga or axe to indicate to later patrols that the carcass has been found. A cross can be cut on top of the skull, and a chop made between the halves of the lower jaw;

(iv)   Tusks present or absent;

(v)   If tusks present, were they cut out or pulled out of the skull without cutting by the patrol;

(vi)   If tusks absent, had they been cut out of the skull or pulled out without cutting? (Note if the animal was a naturally tuskless female or had only one tusk);

(vii) Length of tusks, right and left;

(viii) Circumference of tusk at base, right and left;

(ix)   Length of teeth: front and rear (longest point);

(x)   Width of teeth: front and rear (widest point);

(xi) Length of lower jaw, measured by placing a straight stick (i.e., rifle barrel) across the jaw at its rear point, and measuring the straight line from the center of this stick to the front point of the jaw;

(xii) Shoulder height;

(xiii) Elephant pregnant or lactating; and

(xvi) Whether dependent calf killed at the same time.

c. **Dead Rhino**: A form will be provided for rhino and the data recorded in the same way. If the carcass has not been found by previous patrols, the form should be sent to the WMO by the first available transport.

16. **ARRESTS**:

When a poacher is arrested in the field, he is usually quite frightened and confused and may give information that he would refuse when he has had time to calm down. The man should, therefore, be questioned as soon as possible after arrest and the following information recorded:

a. Name and address;

b. Names and addresses of his companions;

c. What were they doing;

d. When did they enter the park;

e. Where did they sleep;

f. Details of animals killed; who killed the animals;

g. Details of firearms carried; who are the owners;

h. Details of any connections with previous cases; and

i. Any other items of interest.

17. **HABITAT NOTES**:

Record any details of habitat that you consider to be of interest, in particular on the following topics:

a.   **Water**: Record whether water is common or scarce, and whether it is clean, dirty or saline.   In the rains, record whether the water in the dambos is deep and flowing.

b.   **Grass**: Record what state of growth it is in, i.e., short green, tall green, tall dry, fresh burn, old burn, etc.

c.   **Trees**: Record the state of growth of the trees, i.e., fresh leaf, old leaf, dry leaves, leaves fallen, flowers, seeds, etc. Record whether there has been much recent damage by elephants.

d.   Record any observations of interest concerning signs of wildlife, i.e., tracks and droppings, heavy grazing signs, etc.

e.   Record notes on the distribution of tsetse fly, i.e., whether tsetse absent, present, abundant, etc.

f.   Record any signs of old human activity or settlements, i.e., pottery, rock paintings, ng'anjos, villages, fortified villages, etc.

18. **GENERAL**:

Reports should be written in as much detail as possible. Put in anything that you consider to be of interest, whether it is mentioned in these instructions or not. If you are in doubt about any of these instructions or any other matter, do not hesitate to discuss it with your patrol leader or any senior staff member. If you are not sure about anything, say so. Do not invent information that you cannot rely on.

ELEPHANT DEATH REPORT FORM

**TAG
NUMBER**.........................**LEDGER NO**...........**IVORY NO**..............

1. Found by: ....

2. Date found: ....

3. Location: ....

4. How was carcass found? ....

5. Cause of death: ....

6. Reasons for stating above: ....
    ....
    ....
    ....

7. Estimated date of death: ....

8. State of carcass: Fresh, rotten, bones with some dry
    flesh or skin, clean bones, old bones scattered ....
    ....

9. Meat taken by poachers? ....

10. Drying rack present: ....

11. Identity of killer: ....

12. Mark or number from previous patrol? ....

13. Tusks present/absent: ....

14. Tusks cut or pulled out: ....

15. Tusk length: Right ....; Left ....

16. Tusk circumference: Right ....
    Left .... (At lip)

17. Tusk weight: Right ....; Left ....

18. Length of teeth: Front ....;
    Rear .... (Lower jaw)

19. Width of teeth: Front ....;
    Rear .... (Lower jaw)

20. Length of lower jaw: ....

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21. Sex: ....

22. Shoulder height: ....

23. Pregnant or lactating: ....

24. Dependent calf killed? ....

NOTES: (Any other items of interest): ....
....
....
....
....

RHINO DEATH REPORT FORM

TAG
NUMBER.........................LEDGER NO...........IVORY NO..............

1. Found by: ....

2. Date found: ....

3. Location: ....

4. How was carcass found? ....

5. Cause of death: ....

6. Reasons for stating above: ....
    ....
    ....
    ....

7. Estimated date of death: ....

8. State of carcass: Fresh, rotten, bones with some dry
    flesh or skin, clean bones, old bones scattered ....
    ....

9. Meat taken by poachers? ....

10. Drying rack present: ....

11. Identity of killer: ....

12. Mark or number from previous patrol? ....

13. Horns present/absent: ....

14. Horns cut or pulled off: ....

15. Horn length: Front .... Rear ....

16. Horn circumference at base: Front ....
    Rear ....

17. Horn weight: Front .... Rear ....

18. Length of jaw: ....

19. Teeth: Juvenile, Adult, sharp, worn, very worn: ....
    ....

20. Width of feet: Front ....
    Rear ....

21. Shoulder height: ....

22. Sex: ....

23. Pregnant or lactating: ....

24. Dependent calf killed? ....

NOTES: (Any other items of interest): ....
....
....
....
....

CHAPTER 22

LAW ENFORCEMENT PROGRESS IN KASUNGU NATIONAL PARK

BY

B.A. CHINZINGA

1.   INTRODUCTION:

The law enforcement efforts in Kasungu National Park, during the year 1984, can best be described as relatively successful. The marriage among patrol programs, poaching situation at a particular time, available funds and productivity, though not easy, in some cases produced the desired products. The conviction return, for example, though slightly thinner than previous years, almost compares favorably with that of 1983. The future so far is promising as game sightings in areas previously deserted are becoming increasingly good.

Some people, particularly the regular browsers of Sam Chire articles, may perhaps be shocked at this almost sweeping conclusion of events for 1984. How come the KNP poaching situation is said to be almost contained, whereas Sam had strongly and emphatically asserted the gift for prosperity is threatened; particularly by poaching.

2.   PATROL PROGRAMS:

The main aim of patrols is to deter public interference in the protected areas for the excellence of our professionalism requires as little public interference as possible. Patrol programming during the year under review did not lose sight of this main aim. In order that effectiveness is achieved, patrols were properly planned. This planning involved, among other things, review of previous work, i.e., what the poaching atmosphere was during the past two or three years at this time, what are recent reports about those areas we plan to visit, what are the likely disturbing factors--patrol group composition at each camp, field equipment availability, health status of people, etc., how should the patrol groups be deployed, etc. Despite the thin allocation of funds, patrols were systematic, regular, in many cases effective, and coverage almost good. For example, many tusks were recovered, some we suspect may have been laying in the bush for nearly five years. Patrol reports reported animal deaths, plant destruction, gunshots, and many other things even in some areas which were previously reported as gaps.

3.   PATROL PLANNING USING MAPS:

Patrol route and the observations made along there are an important aspect of patrol report. Before any patrol group starts the day's work, a report writer is nominated. His main responsibilities are to take all the notes about the group's movement on that particular day and along that particular route. Direction, times observations made, distances, etc., are all recorded. In order to do this properly, the scouts should have a knowledge of map reading.

During the year under review, therefore, the usual descriptive patrol program was changed and a map system developed. In this method, a block-like system of an area is developed, on a map of the park. These are areas that we would want people to patrol on given periods. Though the boundaries are imaginary, an attempt is made at following as many natural boundaries as possible. Area size is based on group's optimum performance, terrain, vegetation density and frequency of illegal activities. It is only the supervisors who keep copies on which all patrol areas appear.

Apart from the boundary, only period is indicated. Decision on patrol routes is that of the patrol leader and largely depends upon the group's findings.

About five distinct advantages can be claimed for the method:

a.   It assists to visualize, fit in and appreciate the patrol route in each area. This is important because the leader can effectively plan his operations.

b.   If two or more places in the area have similar names and there are adjacent camps, confusion at the two groups aiming for the same place are eliminated and waste prevented.

c.   The leader has the picture of work at hand and can easily plan his operations.

d.   It is a good management principle where people work on their own for long periods.

e.   It assists in quick assessment of the area coverage which is essential when reviewing previous work.

4.   PATROL EFFORTS:

The acclaimed success for 1984, perhaps unlike any other year in the past, did not come in easily. The austerity budget had been announced. In addition, government changed the rate of subsistence allowance. Before the change a Scout SC.III or two was at 75t per night out. The new rate did put him at K5.00 per night out.

For effective deterrence of illegal activities, patrol groups have normally to leave their resident camps and patrol other places. On the average, they are out for five nights per patrol. From 1982, the average nights out per patrol group per month has been 15 nights. This is considered the patrol optimum for the people to also have time to rest and stay with their families. It must be mentioned here that the change in the rate of subsistence was truly a warm welcome. We believed it was to be an extra incentive particularly in this type of job where people have to work on their own for a long time and also under really severe and hard conditions. Distances to cover per day are long and almost always the people have to work overtime. How can people stay at their temporary camp when they have heard a gunshot within the vicinity?

Between 1977 and 1981, poaching atmosphere in KNP is believed to have reached almost its peak. Many elephants were killed. Management policy had to change. As already noted, number of man-days was changed (Table 1). Our efforts, therefore, for 1984 have been to maintain the status quo started in 1982 and where possible improve.

TABLE 1

MAN-DAYS AND NO. OF ARRESTS

Month	Man/Days	No. of Arrests
January	252	9
February	278	10
March	293	12
April	256	8
May	350	1
June	283	11
July	346	4
August	384	1
September	368	3
October	388	6
November	307	7
December	312	9
TOTAL	3,817	81

In spite of the financial bottlenecks, the total number of man-days increased. This increase was partly brought about by the introduction of base patrols. In order that the 15 nights out per month per patrol group be maintained while at the same time spend the allocated funds within given limits, each patrol group had to spend ten nights out. This was 14 working days as some days are spent in going and coming to and from areas assigned for each patrol trip. Base patrols involved five effective days (i.e., mode and style of patrol was the same as long patrols).

Also, efforts to contain the poaching situation continued. For example, areas which were reported as gaps in recent patrol analysis were covered. Particular attention was given to those areas considered vulnerable. Bimonthly evaluation of our efforts and success continued and cases reported outside the park were followed with the assistance and untiring efforts of Kasungu Police, party officials or traditional leaders. The patrol deterrence has been good and number of arrests remained within a good range. Number of key animals and other animals killed dropped. About seven elephants and six buffaloes were killed (see Table 2). Patrol programming was proper, objective and adaptive.

TABLE 2

ANIMALS KILLED BY POACHERS EACH MONTH: 1984

ANIMALS	M O N T H S											
Species	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Elephant	-	1	-	-	1	1	1	1	1	1	-	-
Buffalo	-	-	-	1	-	1	1	1	1	1	-	-
Zebra	-	-	-	-	-	-	-	1	-	-	-	-
Sable	-	-	-	-	-	-	-	1	-	-	-	-
Hartebeeste	-	-	-	-	-	-	-	-	1	-	-	-
Roan	-	-	-	-	-	-	1	-	-	-	-	-
Reedbuck	-	2	-	-	-	-	-	1	-	1	-	-
Warthog	-	-	-	-	-	-	-	-	3	5	-	-
TOTALS	0	3	0	1	1	2	3	5	6	8	0	0

Supervision too, of field staff was by all senior staff and like patrol programs, was planned, objective and adaptive. It extended also to the improvement of working conditions. For example, when patrol reports were submitted and before the start of the next patrol, patrol reports were discussed with each patrol team. In the field when a supervisor could be with any of the patrol groups, and at the end of each patrol, observations made could be brought to the attention of the group. In addition to amending the patrol instructions, supervision has contributed to the overall improvement in both reliability and accuracy of the patrol reports.

As already noted, consideration was also given to the general working conditions as an important aspect of supervision. Many of our staff work on their own. We also expect reliable and accurate patrol reports from them. Maintenance and improvement of staff working conditions were not lost sight of in 1984. Two houses were built at Kangwa for assistant scouts. All other houses in many camps were maintained. Service roads were slashed earlier on in the year and the mobile clinic which looks at the health and welfare improvements of families, continued to operate throughout the year.

Game visibility bore signs that deterrence had been maintained. Reports of game sightings in areas previously deserted were good. Elephants in Kangwa are common.

5. CONVICTION RETURN SHEET:

While there has been a slight drop in the conviction return sheet for 1984, compared to 1983, the 81 convictions for 1984 are just about the average of annual convictions (see Figure 1). Since 1977, the average

annual conviction is 83. The drop in arrests from the 1982 record of 239 is suspected to be due to a decrease in the available stock of poachers (Kasungu is believed to have a fairly constant pool of poachers), and perhaps, the once arrested and convicted poachers are adopting methods we are not yet familiar with (see Figures 2 and 3). It is also possible that the environmental education programs are bearing fruit.

FIGURE 1

NUMBER OF ARRESTS EACH MONTH

1984
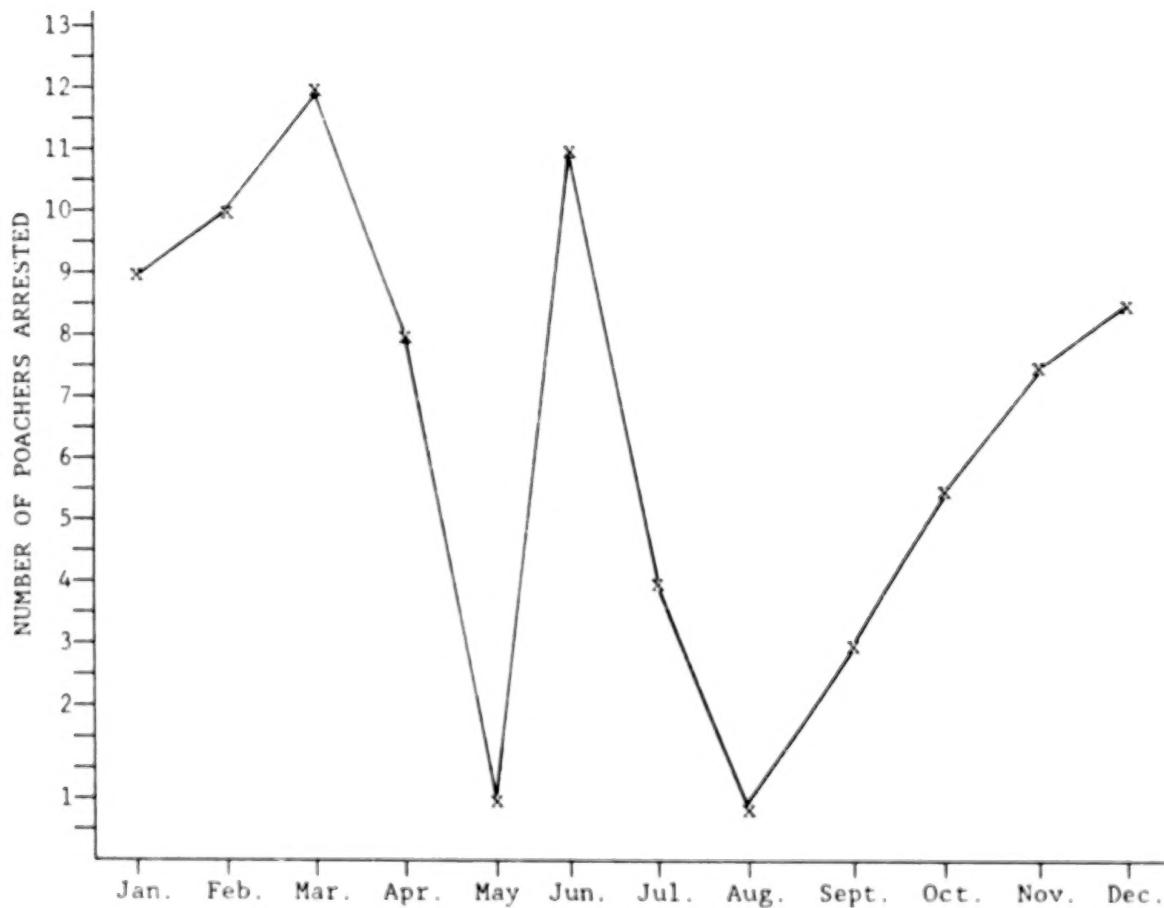
FIGURE 2

CONVICTION RETURN SHEET SINCE 1977
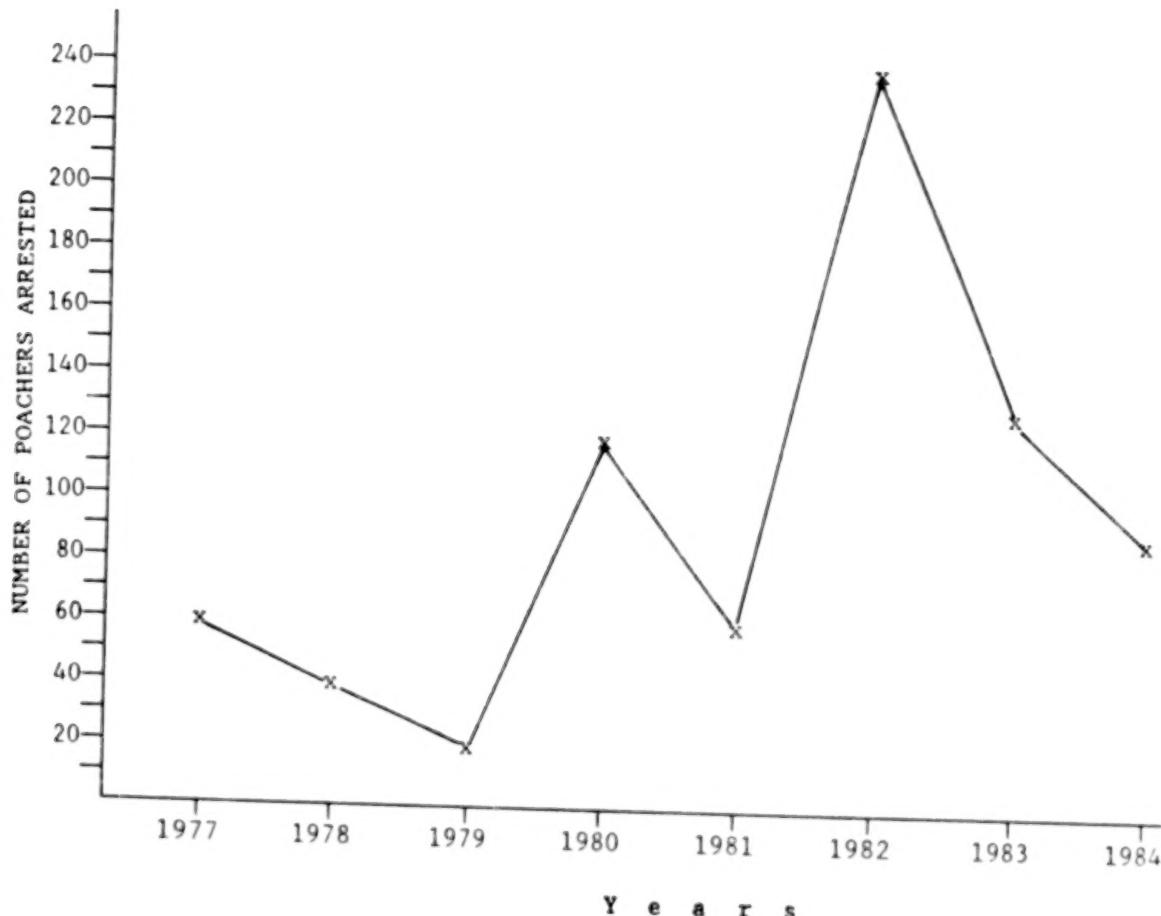
FIGURE 3

NUMBER OF FIREARMS SEIZED EACH YEAR SINCE 1977

379
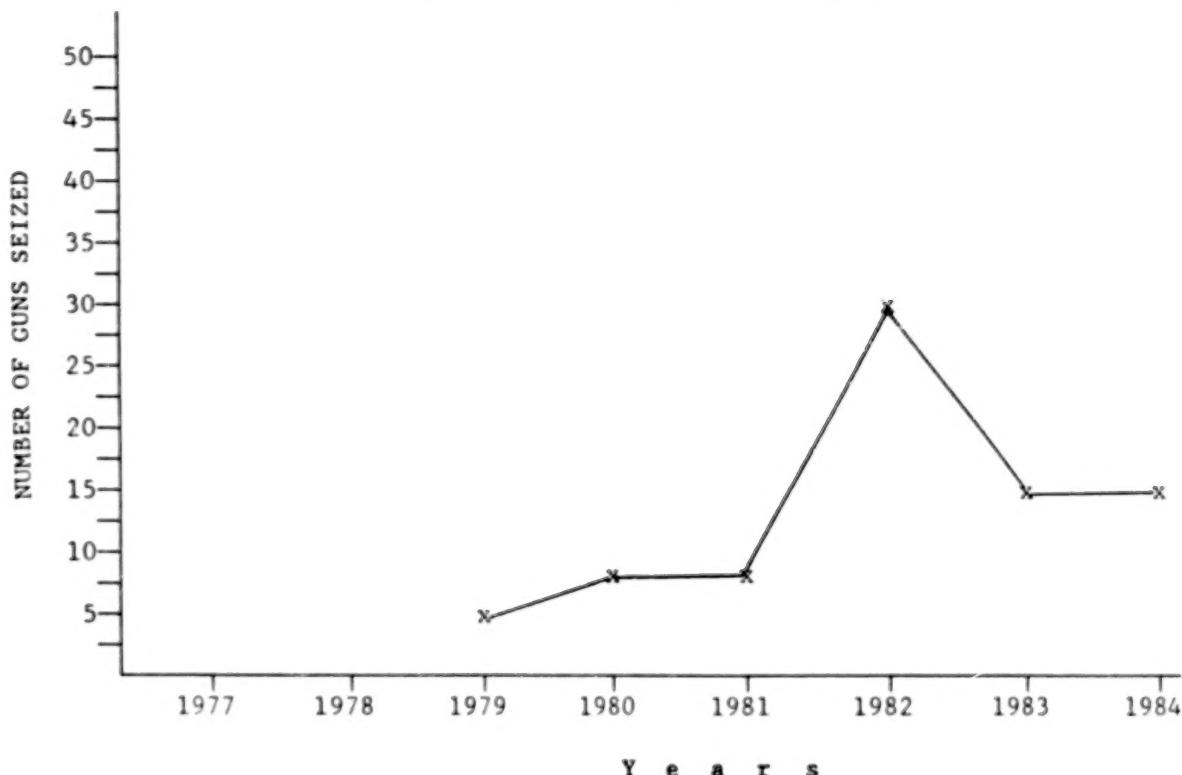
Another thing worth noting, is that court fines continued to be good and deterrent. Court fines of about K800.00 per person were not uncommon.

Evidence collecting techniques were also improved upon. A file for the storage of poacher's information was opened. Depending on the seriousness of the case, fingerprints and photographs of accused were taken. This information bank has proved helpful because circumstances which led to a particular case could be reviewed before a witness could appear in court; activities of poachers regarding movements, objectives, manner of poaching, weapons used, etc., were known and kept.

In short, therefore, the poaching situation in the park was almost contained. Patrol programming was well-mated with troop deployment and patrol optimum of each camp. Despite the financial bottlenecks, working conditions were maintained, improved and patrol efforts increased. The year 1985 may see, perhaps, more improvements.

CHAPTER 23

LAW ENFORCEMENT AND PUBLIC RELATIONS:
A CASE HISTORY

BY

H.E. NZIMA

1. INTRODUCTION:

This short paper summarizes the author's experiences in his endeavors to win the support of the local people, against a law enforcement background, for a newly created aquatic park in the southern part of Lake Malawi. Major difficulties encountered in explaining ecological and conservation concepts to a public with an antagonistic value system are given. It is concluded that with the best public relations going, a project will not gain public support if it threatens the value system of that public.

2. BACKGROUND:

Lake Malawi National Park, created in 1980, covers the northern part of the Nankumba Peninsula, 12 offshore islands, and 100 meters offshore water zone about its land area. Totalling about 87 km^2, the park was created to protect the brightly-colored rock fish and its rocky shorelines. The park also protects the woodland and fauna on its terrestrial and island components.

Within and around the terrestrial component of the park are situated subsistence fishing communities with a total population of over 6,000 people. These communities do not raise crops or livestock; they entirely depend upon the local fishery industry. The communities also entirely depend on the terrestrial component of the park for fuel wood, building poles, thatching grass, etc.

3. LAW ENFORCEMENT:

The major effort in law enforcement was (and still is) directed at protecting the 100 meter water zone around the terrestrial and island components and to regulate utilization of forest products from the terrestrial component. Fishing within the 100 meter zone is prohibited and so is collection of forest products from islands. Collection of forest products from the mainland terrestrial component is regulated by a system of permits. The implications of these law enforcement measures are that certain fishing grounds are closed to fishing; that people have to look for alternative fishing areas. However, the 100 meter water zone is a very productive zone, supporting a substantial proportion of the local fishery industry. These measures also mean that for the first time, people have to pay for forest products.

4. PUBLIC RELATIONS:

To many people in the Lake Malawi National Park area, the concept of a national park was a novel one. Our efforts at protecting the resources were, therefore, preceded by a year-long public relations campaign the purposes of which included:

a. explanation of the concept of a national park as a form of land use;

b. explanation of conservation values; and

c. explanation of park rules and regulations and why they exist.

Numerous meetings were held with village headmen, chiefs, party leaders and civil servants. There was continuing informal contact with these leaders, and other members of the public. Occasional field trips would be arranged to explain certain points on site. These constant interactions revealed that the peoples' biggest concern was the closure of the most fertile fishing grounds embodied in the 100 meter water zone. These concerns forced the Department of National Parks and Wildlife to re-examine its management plan for Lake Malawi National Park. At an inter-departmental meeting held at Monkey Bay in March, 1984 a subcommittee was set up to draw up a plan which could realistically accommodate peoples' needs. The plan that eventually emerged was one based on a system of zoning, allowing for various uses, including traditional fishing.

Before this management plan was worked out, however, a low-keyed law enforcement program was being implemented. Violators of park water space had their fishing gear impounded, explaining to them park rules and regulations before the fishing gear could be returned to them. However, no people were hauled into court at these early stages.

5. RESULTS OF PUBLIC RELATIONS CAMPAIGN:

It became apparent in the course of these public relations campaigns that people could not easily relate to most ecological concepts and con-servation and values. Although they could grasp the more straightforward values such as economic values, they could not see how they directly fitted into the picture. However, people were able to quite clearly see the negative values of the park. The people complained about government taking away the most productive fishing areas; they complained about government taking away the only source of fuel wood, thatching grass, etc.

A year of continuous public relations with minimal law enforcement appeared to have been successful as far as understanding park rules and regulations went. The people, according to political and traditional leaders, appeared to understand why the park, plus the rules and regula-tions governing it were there. But one could still sense the "Antigame sentiment." People continued to fish in park waters and illegal collecting of forest products was as rampant as ever. The presence of park personnel seemed to be completely ignored. The park was obviously not enjoying much support.

6. HANDS WON AND LOST:

That Lake Malawi National Park had no support of the people around it became clear, when, after a year-long intensive public relations campaign, we hauled into court six offenders. We made a lot of enemies, lost the few friends we had made and certainly made no new ones. There erupted a sharp public outcry. The political and traditional leaders, thought to have been

won over, turned around and demanded an explanation about the arrests. This was an uncomfortable and uncertain period, but law enforcement and public relations still continued.

7. CONCLUSION:

Although Lake Malawi National Park had serious public relations problems in its early stages, not all is lost. The government has from the start advocated a flexible and multidisciplinary approach in solving problems posed by the park. The Forestry Department had planned a fuel wood plantation at the edge of the park to reduce dependence on the park. The Department of National Parks and Wildlife has made a number of concessions in response to peoples' needs. Fishing in certain areas within the 100 meter water zone is now permitted while collection of fuel wood, building poles, and thatching grass has been permitted since the park was declared, although on a regulated basis.

CHAPTER 24

THE MAN-ANIMAL INTERFACE:
AN ASSESSMENT OF CROP DAMAGE AND WILDLIFE CONTROL

BY

R.H.V. BELL

1.   INTRODUCTION--THE MAN-ANIMAL INTERFACE:

Competition between humans and wildlife for resources is a basic feature of man's relationship with his environment. The progressive elimination of wildlife as a threat to life and property has been a primary aspect of human development.

Most large animals and many small ones are incompatible with most human activities. Until the relatively recent past, the conflict was quite evenly matched and humans could only survive by forming concentrated settlements which eliminated wildlife locally (Ford 1971, Parker and Amin 1983). Even in recent years, examples can be found of settlements being abandoned in the face of conflicts with wildlife; I personally have seen cases in the Bangwelu floodplain, Zambia (Grimsdell and Bell 1975) and in the Linyangwa Small Holders scheme, Kasungu and Malawi (Bell 1981a).

The historical pattern, therefore, of man-animal interactions has been one of foci of concentrated human activity in which most wildlife is eliminated, set in a matrix of wilderness where wildlife predominates, and where human uses are confined to hunting, gathering and, in some areas, pastoralism. Between settled areas and wilderness is the man-animal interface, a narrow zone in which most of the conflict is concentrated (Ford 1971, Parker and Amin 1983, Parker 1984, Parker, this volume). The recent trend has been for the foci of settlement to expand at the expense of the wilderness, so that the current picture is one of islands of wilderness in a sea of settlement, with a contracting interface around diminishing islands.

The man-animal interface is a rolling zone of attrition in which wildlife has been eliminated, but it has been utilized in the process. A high proportion of ivory exported from Africa during this century has come from elephant populations eliminated in the interface before expanding settlement (Graham 1973, Parker and Amin 1983), while the majority of wildlife products, i.e., small animals, vegetable products, etc., used by rural populations come from the interface (cf., Marks 1975, Bell 1979a). It is, therefore, no accident that government involvement in wildlife-human interactions in Africa initially concentrated on the interface, specifically as departments of game control. In this role, they both improved conditions for rural development and generated revenue, particularly from ivory.

2.   THE ROLE OF WILDLIFE CONTROL IN CONSERVATION:

The relatively recent emphasis on conservation represents a radical departure from this longstanding pattern of wildlife-human interactions. The object is to check the progressive erosion of the wilderness islands and to stabilize the man-animal interface. In this new scenario, wildlife control retains a key role in reducing negative attitudes towards wildlife and preventing the last islands of wilderness from being washed away.

The point is this: the reason we need to spend effort and money on conservation is that, in the popular perception, the balance between benefits and deficits due to wildlife is not sufficiently favorable. Pressures on land and wildlife are due to their perception both as unused

resources and as sources of competition and danger. A high proportion of conservation effort and expenditure is devoted to countering such attitudes, by law enforcement, public relations, education and various subsidies. As noted earlier (Chapter 3), the more closely conservation corresponds with people's short-term interests, the cheaper and easier it is.

One may generalize by saying that the cost of conservation is proportional to the perceived excess of deficits over benefits due to wildlife. One major factor in this equation is the perceived threat posed by wildlife to life and property. Therefore, any action that can reduce the size of this perceived threat will reduce the overall cost of conservation and make the achievement of conservation goals easier.

However, it is now necessary to distinguish clearly between the roles of wildlife control and wildlife utilization, roles which historically have been closely intertwined. The two roles can be, but are not necessarily, compatible; utilization is not always the best form of control and vice versa. The relationship between conservation, utilization and control is best worked out in relation to a regional land use plan, integrating wildlife with other forms of activity.

3.   THE FORMS OF WILDLIFE CONTROL:

The essence of wildlife control is to bring wildlife densities down to levels that are compatible with the type of land use concerned. Tolerable densities vary between types of animal, types of land use and types of people. (Buddhist communities in Asia are very reluctant to kill wildlife, leading to unexpectedly high wildlife densities in settled areas and the phenomenon of the "pocketed elephant," cf., Blair and Noor 1979.)

Wildlife occurs in more or less discreet populations separated by physical or ecological barriers from other populations. Reduction of wildlife to tolerable densities can be carried out by eliminating entire populations, as with the Ruanda elephant (Haigh, et al., 1979), by reduction of density over whole populations, as with the red locust, or by creation of density gradients within populations between unsettled and settled areas, probably the commonest form of large mammal control and standard procedure at protected area boundaries.

There are five main sets of methods in common use, which may be summarized as follows:

a.   Raising of the tolerance threshold by compensation, subsidies, propaganda, etc.;

b.   Deterrence by means of shooting, fire, noise, general disturbance and by chemical deterrents;

c.   Removal of individual animals by hunting, trapping, poisoning, etc.;

d.   Physical barriers, including rock barriers, ditches, fences and electric fences, etc.; and

e. Biological control, through modification of habitat, introduction of predators, parasites and diseases, and introduction of sterile males, etc.

Of these, the last is the least important in African wildlife management, although biological control of tsetse fly by shooting of host mammals and introduction of parasites and sterile males has been attempted with mixed results (Ford 1971, Markham 1984).

As mentioned above, the choice of the appropriate form of wildlife control should be made in relation to the overall land use plan for the region, in which areas appropriate for conservation, utilization and control are identified in relation to the physical and biological resources and patterns of human use for the area (see Martin and Taylor 1983). In making the assessment, we are dealing with a matrix with the following four dimensions:

(i) The physical, biological and human features of the area (i.e., the landscape type);

(ii) The form of wildlife control;

(iii) The costs and benefits of each form of control; and

(iv) The sectors of the community affected.

4. COSTS AND BENEFITS OF WILDLIFE CONTROL:

In evaluating the alternative wildlife control strategies, we need to consider a range of costs and benefits as follows:

a. Costs of Wildlife Damage:

(i) Costs in loss of life and in stress;

(ii) Costs in loss of property, i.e., crops, livestock, fencing, etc.;

(iii) Costs in unfavorable public opinion; and

(iv) Costs of countering unfavorable public opinion, i.e., law enforcement, public relations, education, compensation, subsidies, etc.

b. Costs of Wildlife Control Measures:

(i) Costs of installation of control measures;

(ii) Costs of maintenance of control measures;

(iii) Ecological costs of control measures, i.e.,

(1) Drain on wildlife populations;

(2) Prevention of population dispersal;

(3) Compression of wildlife populations;

(4) Modification of habitats; and

(5) Damage to nontarget species.

c. **Benefits from Wildlife Control Measures:**

(i) Reduction of costs due to damage to life and property;

(ii) Improvement of public attitudes towards conservation;

(iii) Reduction of costs required to counter effects of unfavorable public attitudes; and

(iv) Generation of revenue and products derived from, or allowed by, wildlife control measures.

5. SECTORS OF THE COMMUNITY AFFECTED BY COSTS AND BENEFITS:

In considering the various costs and benefits of different wildlife control measures, we must distinguish clearly between the costs and benefits as they affect different sectors of the community.

The primary division is between the rural population on the one hand, and the government represented by a conservation agency on the other. However, in any detailed analysis, it is necessary to subdivide these groups further into subgroups with distinct interests. Within rural communities, we need to distinguish between people living at different distances from wilderness areas and involved to different degrees in the man-animal interface; between cash crop farmers and subsistence farmers, commercial hunters, subsistence hunters and livestock owners. We also need to consider urban communities. Within the government, we need to distinguish between elected officials (chiefs, members of parliament, etc.) who are primarily concerned with public opinion; central government, which is primarily concerned with considerations of economics and national prestige; and conservation agencies which are concerned with meeting their conservation objectives while staying afloat financially. Within conservation agencies, it is also realistic to distinguish between those branches concerned with protected area management (conservation) and those concerned with wildlife control. It is in the interests of wildlife control sections to exaggerate the size of the man-animal conflict, since their prestige, financial allocation and job security (to say nothing of purloined revenue from animal products) depend on it. Wildlife control sections will always tend to perpetuate rather than solve the problem of the need for control; this is a strong argument in favor of integrating control work under protected area management at a junior level, so that control interests are organizationally subordinate to conservation interests.

6. EVALUATION OF WILDLIFE CONTROL MEASURES:

Although wildlife control has historically been a fundamental aspect of man-animal interactions; although it has been the major form of government involvement with wildlife in Africa during this century; and although many conservation agencies originated as wildlife control departments, it is a remarkable fact that very few attempts have been made to evaluate the alternative wildlife control measures.

The basic stock in trade of wildlife control departments has been control shooting. Graham (1973) provides entertaining insights into this activity, and I think it is fair to say that no quantitative evaluation of the costs and benefits of this method has ever been carried out. Its continued use seems to be due to the lack of a practicable alternative, to its value as a public relations palliative, and to its ability to generate revenue, rather than to any real evidence that control shooting reduces the rate of damage to crops (except in cases of local extermination).

Various forms of physical barrier have been tried in situations where wildlife impinges on dense settlement with high value crops. The main forms have been conventional fencing, ditching and electric fencing. Conventional fencing has been used particularly in South Africa, an early example being the elephant-proof fence at Addo National Park, followed by the elephant-proof fence on the eastern boundary of Kruger National Park. These fences are constructed of railway line imbedded in concrete and strung with thick lift or mine cable, costing up to US $20,000 per kilometer, and requiring considerable maintenance. Even so, they are broken regularly except in the case of the "trained" elephant population at Addo. Rhino and small game proof fences are common in South Africa, for example, around the Natal and Pilanesberg Game Reserves; they consist of steel uprights, 1 cm cable and chain link up to 2.5 m high and cost between US $10,000 and US $20,000 per kilometer; they are rarely crossed by wildlife. A trial sector of conventional fence with steel uprights and high tensile wire was erected in Meru National Park, Kenya in 1979 for about $15,000 per kilometer, with mixed results with elephants.

To summarize, conventional fencing is effective against most species except elephants if sufficiently strong; no conventional fence yet designed has been fully effective with elephants except at Addo. However, all conventional fences are extremely expensive to install and maintain and are scarcely appropriate to large African conservation areas with tight budgets and poor access.

A significant improvement on conventional fencing was achieved by Woodley (1965) in the treetops salient of the Aberdares National Park, Kenya, by the construction of a ditch immediately inside the fence. This prevents elephants access since elephants cannot negotiate a steep-sided ditch. However, the combined fence and ditch is expensive to construct (probably US $10,000/km at current costs) and requires constant maintenance; it is also liable to gullying and siltation and is only suitable in certain soils. A similar fence/ditch combination was used for small game in Lengwe National Park, Malawi and was moderately successful while it was maintained.

Electric fencing has been tried on a number of occasions, for example, by Vesey-Fitzgerald (1968) in Manyara and Arusha National Parks, Tanzania. Prior to about 1978, the "first generation" electric fencing systems were insufficiently powerful to provide reliable protection from elephants, rhino and buffalo and the trials were discontinued. However, since about 1978, a "second generation" of electric fencing energizers has become available which, using solid state technology, has transformed the science of megaherbivore control and brought it within the financial and logistic capabilities of many African conservation agencies. Details are given in a later section.

The greatest problem in evaluation of wildlife control measures is that the tests have not been conducted according to the adaptive management concept. In particular, attempts have rarely been made to assess the costs of wildlife damage in terms of property and public relations, or to assess the benefits of control measures in terms of property and public relations savings. Control measures have not been designed as trials and have not been used as such. The two major exceptions to this omission are the trials carried out by the Federal Land Development Agency in Malaysia, and the Linyangwa case study, Malawi, to be described in the next two sections.

7.   THE FELDA TRIALS, MALAYSIA:

The most extensive series of trials on the control of megaherbivores was carried out by the Federal Land Development Agency, Malaysia, and reported by Blair and Noor (1979). The background to this study was that, in the 1970s, FELDA opened up several million hectares of virgin jungle for agricultural development, primarily with oil palm and rubber plantations, with an investment of hundreds of millions of dollars. By 1977, it became clear that damage by wildlife, particularly the Asian elephant, was destroying up to 10% of the investment annually, that is, up to US $20 million annually. This was the more impressive in that the Asian elephant is an endangered species with a total population in Malaysia estimated at between 600 and 2,000 animals (Blair and Noor 1979, Olivier 1978).

The FELDA situation provided ideal circumstances for adaptive management in wildlife control, firstly, because the project was controlled by agriculturalists with a direct interest in solving rather than perpetuating the problem; secondly, because for the same reason adequate records of damage were kept, through which control measures could be evaluated; and thirdly, because of the financial scale of the damage, adequate funds were available for testing control measures. For these reasons the FELDA trials stand out as the most, if not the only, rigorous trial of wildlife control involving megaherbivores.

The FELDA trials examined the efficacy of conventional fencing, ditching and second generation electrified fencing. Briefly they found that conventional fencing was prohibitively expensive and ineffective in reducing damage rates to cost-effective levels. The same was true of ditching which was expensive to install and maintain, caused problems of erosion and siltation and could not be used in sandy or marshy areas; with these problems it was ineffective in reducing damage rates and was rated unsuccessful.

FELDA was responsible for introducing second-generation electric fencing to megaherbivore control in 1978, and immediately obtained encouraging results. Installation costs were in the region of US $1,000 per kilometer and damage rates fell dramatically. Since 1980, FELDA has adopted electrified fencing as its control method of choice, using hardwood poles without insulators and five strands of 13-gauge wire. The rate of elephant damage to plantations has dropped to insignificant proportions.

In the FELDA trials, damage rates were monitored in great detail, individual damaged plants being counted. Costs of damage were estimated in terms of a full economic analysis involving development costs, planting costs, lost revenue from damaged trees, discounted cash flow, etc. (Blair and Noor 1979). Because of the high value of the crops at risk, the cash value of the damage was very high, amounting to millions of dollars per year. In this situation, the assessment of control measures is simplified in that it can be evaluated in straightforward financial terms. Control measures such as electric fencing can be rated cost-effective quite simply in that the value of damage prevented exceeds the cost of protection over the fence's life.

In African small holder situations, the position is different in that crops are usually more dispersed and of lower unit value so that damage is more difficult to assess and when assessed it is of lower cash value and usually does not justify control measures in simple cash terms. The Linyangwa case study was designed to examine the strategy of wildlife control in such a situation.

8. THE LINYANGWA CASE STUDY, MALAWI:
(See Bell 1981b, 1982, 1983, 1984a)

a. Background:

The Linyangwa Small Holders scheme is located on the southeastern boundary of Kasungu National Park, Malawi. It is an area of about 130 km^2 containing about 620 small holdings of flue-cured tobacco and food crops, primarily maize. The scheme was initiated by the British Commonwealth Development Corporation in 1976 and is now managed by a parastatal of the Malawi Government, the Kasungu Flue-Cured Tobacco Authority (K.F.C.T.A.).

The Linyangwa scheme is situated in formerly unsettled land adjacent to the major elephant concentration area in Kasungu National Park. The latter is an area into which elephants have been progressively compressed by illegal activity in the north and west of the park since the mid-1970s. As a result, the Linyangwa scheme area has been a source of conflict between wildlife and agriculture since its inception, the main problem species being elephant, buffalo, bushpig, monkey and baboon, with minor damage caused by eland and kudu. Fortunately none of these species cause any but minor damage to the high cash value crop, tobacco, so that most of the concern is centered around the low cash value crop, maize.

The Linyangwa scheme area and the immediately adjacent land, totalling about 20 km or about 13% of the total park boundary, account for about 75% of all wildlife damage to crops on the boundary of the park.

As a result of this concentrated effort, two hunter units (one hunter plus one porter plus equipment) have been stationed on this sector of boundary since 1976. At certain times additional two hunter units have been added. These hunter units are instructed to visit gardens that have been damaged by wildlife; they spend nights in the gardens; if the animals return, the hunters are instructed to attempt to scare the animals away with signalling pens (ejecting loud bangers); if the animals return again, the hunters shoot one or two. In this situation, they dry the meat and sell it to the local population at a very cheap rate, then return the ivory to the Department of National Parks and Wildlife.

By 1979, a trend had been established in which about 15-20 elephants per year were being killed outright in the Linyangwa and adjacent areas and perhaps as many again wounded, of which possibly half died later in the park. Thus up to 30 elephants per year were being killed on this boundary from a total population of about 800. This amounts to about 3.75% of the population. Combined with the relatively high levels of illegal activity current at that time (see Bell on monitoring of illegal activity, this volume), the combined deaths due to illegal hunting, crop protection shooting and natural mortality seemed to be clearly in excess of the recruitment to the population. For this reason, the Wildlife Research Unit was asked to investigate the situation, to assess the actual costs of crop damage by wildlife and to evaluate alternative methods of control. In the event, the methods evaluated were:

(i)   Self-protection by small holders;

(ii)   Control shooting;

(iii)   Chemical deterrents;

(iv)   Plantation of exotic fuel woods (blue gums);

(v)   Conventional fencing; and

(vi)   "Second generation" electrified fencing.

b.   Monitoring Crop Damage:

Before evaluating control measures, the first step was to develop a method of monitoring crop damage. Our requirements were that the method be simple, quick and practical, so that it could be applied to extensive areas in a relatively short time, and give at least a semiquantitative index of the amount of damage.

Our method refers specifically to maize, but could be easily modified for other crops; it follows the following steps:

(i)   We estimate the area of each field by pacing; and

(ii)   We estimate the quality of the crop in the categories good, medium or poor. This refers to the quality of the crop *before* damage. A mean production figure in bags of maize per hectare is given to each quality class on the basis of

advice from agricultural assistants in the area. For Kasungu we use the following values:

Good = 17.5 bags per hectare;

Medium = 12.5 bags per hectare; and

Poor = 7.5 bags per hectare.

(iii)   From the above, we estimate the number of bags that would have been produced if there had been no damage;

(iv)   We estimate the proportion of crop destroyed by area in the following damage classes: 0 = no damage; 1 = 1-10%; 2 = 10-25%; 3 = 25-50%; 4 = 50-75%; 5 = 75-90%; 6 = 90-100% destroyed;

(v)   We identify the animal species causing damage in the order of the amount of damage caused (we find it very difficult to estimate the relative proportion of damage caused by different species since they tend to obscure each other);

(vi)   We estimate the number of bags lost due to damage, using the following representative loss values for each damage class: 0 = 0%; 1 = 3%; 2 = 15%; 3 = 30%; 4 = 50%; 5 = 75%; 6 = 100%. Note that these values are below the median for each class; this is, firstly, because the frequency distribution of percent damage is skewed towards low value so that the mean for each damage class is below the median, and secondly, to compensate for the usual tendency to overestimate damage. Damage class 6 is an exception, since farmers tend to abandon heavily damaged crops;

(vii)   In calculating the damage attributed to each species of animals, we usually allocate all the damage in any one garden to the top ranking species in that garden. This "winner-take-all" system is somewhat arbitrary and inaccurate, and it resembles the British electoral system in that it can lead to dramatic shifts in the apparent damage picture in response to trends in which one species overtakes another in damage caused. The only way around this problem is some form of "proportional representation" based either on a quantitative estimate of damage caused by each species, which, as noted above is very difficult, or an arbitrary allocation of damage in relation to rank; and

(viii)   We normally carry out a single damage assessment each season, as soon as possible before harvesting, so that the total damage to standing crops is estimated. In certain cases it may be useful to carry out repeated surveys through a growing season, for instance, to make "before and after" assessments of control techniques such as chemical repellents.

(ix) The question of sampling strategy is important. In the Linyangwa case study, we estimate damage in all 600-odd small holdings. In this total survey the problem of sampling does not arise. However, when applying the method on a more extensive scale, a valid sampling strategy is essential. This is because wildlife damage is very unevenly distributed both in relation to landscape situation and to distance from wilderness areas. We are aware of cases where regional damage estimates based on extrapolation from high damage localities have led to grossly inflated estimates of overall damage rates. A workable sampling strategy for extensive surveys is to stratify the area, firstly, by land-scape classification and, secondly, by distance from potential wildlife habitat. As will be indicated below, damage frequency declines sharply with distance from such habitat, to the extent that one can identify a "front-line" of settlement which receives the majority of damage. Within each stratum so defined, farms can be selected by a randomi-zation process, for example, by selecting random pairs of coordinates on a map or air photo.

Having developed a method of estimating crop damage rates, we are now in a position to evaluate the ecological and economic aspects of damage by wildlife and to assess the costs and benefits of different control measures.

c.   The Costs of Crop Damage:

The direct costs of crop damage by wildlife have varied considerably in time and space. The highest total cost was recorded in 1983, amounting to about US $5,000 for the Linyangwa scheme area and about US $8,600 for the whole park boundary. Analysis of damage figures suggest the following main factors affecting damage costs:

(i)   The type of wildlife present;

(ii)   The "pressure from wildlife populations;

(iii)   The palatability and vulnerability of the crop to wildlife present;

(iv)   The value of the crop; and

(v)   The defense measures in use.

d.   The Type of Wildlife Present:

In the Linyangwa area, damage has been recorded due to the following large mammals: elephant, bushpig, baboon, vervet monkey, eland and kudu. In general these species contribute to the total damage in the order listed, with elephant and bushpig usually accounting for at least 80% of the damage. The relative ranking of elephant and bushpig varies between locations and between seasons, for reasons that will be examined below.

Damage-causing species can be classified into two major groups, as follows:

(i)   Those species that require a large wilderness refuge such as a conservation area for survival, and which cause damage on brief visits to settled areas. This group includes elephant, buffalo, eland, kudu and lion; and

(ii)   Those species that can survive in small wilderness patches within settled areas without a large wilderness refuge. This group includes bushpig, baboons, monkeys, leopard, crocodile and hippo, as well as most small mammals, birds, reptiles and insects.

The two most important damage-causing species in the Linyangwa area, elephant and bushpig, belong to different classes, and the resulting damage patterns and appropriate control measures are distinct. Elephant damage is largely confined to front-line farms and can be eliminated by interface barriers. Bushpig damage, however, extends throughout settled areas and can only be controlled by local elimination of pigs or fencing individual gardens.

e.   **The "Pressure" from Wildlife Populations:**

This factor is a combination of the density and behavior of wildlife populations, and is illustrated by the pattern of elephant damage in the Linyangwa area. Firstly, elephant density is related to landform (Bell 1981a), higher densities being related to the "valley" landscape units. For this reason, settlements near the Lingadzi Valley have been subjected to heavier pressure than those in "plateau" areas.

Further, while approaching settlements at night, elephants tend to follow stream lines so that farms located near streams are subjected to heavier pressure than those in other land facets. Secondly, bulls appear to have a higher tendency to raid gardens than cow-calf groups (although raiding by the latter is still fairly common), so that farms adjacent to bull areas receive disproportionately more pressure than those adjacent to clan areas. Thirdly, pressure on farms is related to the availability of alternative foods and to the growth stage of crops. Pressure is highest towards the end of the growing season (February-April) when wild grasses are becoming fibrous but maize is coming into seed; there is some indication that pressure is greater in wetter seasons when fibrous growth in wild grasses is more pronounced. Fourthly, pressure on farms in the Linyangwa area rose steadily from 1979 to 1982 during a period of heavy elephant poaching in the north and west of Kasungu National Park which compressed the elephant population against the southeast boundary adjacent to the Linyangwa scheme. During this period, the center of pressure shifted southwards from Blocks 1, 2 and 3 to Blocks 10 and 11 (see Table 2). Following the suppression of poaching from 1982-1984, the elephant population has begun to disperse into its former range and elephant damage has declined dramatically (see Table 2 and Bell 1984a). Finally, pressure may be modified by control measures which affect both behavior and density. These measures will be evaluated below.

f. The Palatability and Vulnerability of the Crop:

The point here is that certain crops are palatable and vulnerable to wildlife while others are not. This is mainly determined by the secondary chemical defenses and the structure of the crop plants. Most food crops (which are selected for low secondary chemical defense capability) are both palatable and vulnerable, particularly maize in mature growth phase. Tobacco, with its high secondary chemical content (nicotine), is generally avoided except for slight damage to the top shoots by browsers (kudu, eland) which are presumably able to detoxify it to some extent. Similarly, blue gum (*Eucalyptus camaldulensis*) is not eaten by mammalian wildlife although in its first three to four years of growth, it may suffer extensive physical damage from buffalo and elephant. In the Linyangwa area in 1981, our data showed distinct differences in vulnerability of different crops in front line farms in areas of equivalent damage risk:

TABLE 1

RELATIVE DAMAGE RATES TO THE MAJOR CROP TYPES: LINYANGWA 1981

	Hectares Planted	Hectares Damaged	% Crop Damaged
Maize	274.0	13.1	4.8
Groundnuts	44.5	0.7	1.5
Tobacco	267.0	0.02	0.008
Blue Gums	1.90	1.3*	0.7

* Physical damage by elephant and buffalo.

The relatively low damage rate to groundnuts is interesting considering that it is a leguminous food crop; perhaps this is due to the fact that the edible part is buried and that the exposed foliage is not selected for edibility and is defended by secondary chemicals.

(Note: A recent survey has shown significant damage to tobacco as a result of intercropping of edible crops (pumpkins), attracting elephants into tobacco gardens. This practice should probably be avoided in high damage risk areas.)

Similar patterns of damage have been noted elsewhere. Damage by blue monkey (*Cercopithecus mitis*) to *Pinus patula* plantations at Zomba and Dedza is concentrated on young shoots with low resin content (Shakespeare,

unpublished data) while in the Malaysian FELDA study, damage by elephants was concentrated on young oil palms, which as Blair and Noor (1979) point out, are closely related to the plants identified by Olivier (1978) as being the preferred food of wild elephants.

TABLE 2

DAMAGE TO FRONT LINE FARMS (IN BAGS OF MAIZE LOST) TO FRONT
LINE BLOCKS, LINYANGWA AREA, 1981-1984

Block	Total Damage				Damage by Elephant Only			
	1981	1982	1983	1984	1981	1982	1983	1984
2	17.8	8.6	13.4	5.8	16.7	4.3	3.9	0.6
3	9.7	4.1	8.7	14.2	9.7	2.1	4.9	1.1
1	102.0	45.0	85.2	36.5	95.9	43.3	24.1	2.6
Police	2.7	4.0	21.6	5.7	2.7	3.7	0	0
Linyangwa	27.0	31.4	66.6	41.5	27.0	22.1	51.8	0.6
6	0	9.9	26.5	15.9	0	2.8	0	0
8	19.3	20.6	44.3	20.7	14.4	13.1	3.8	0.5
10	5.3	39.7	78.2	10.8	5.3	39.7	70.0	6.3
11	17.0	103.9	89.1	15.6	11.4	103.9	86.7	15.6
TOTAL	200.8	267.3	433.8	166.8	183.1	235.1	245.4	27.3

g.   The Value of Crops at Risk:

An important factor in determining the costs of crop damage is the value of the crops at risk. This is in turn determined by ecological and socio-economic factors. Of the three main crops at risk in the Linyangwa area, tobacco is the highest value crop, being worth up to US $3,000 per hectare. Fortunately, wildlife damage to tobacco is insignificant, since significant damage would have put Linyangwa in the high damage cost bracket with the Malaysian oil palm situation and could seriously compromise the future of the national park. The blue gum plantations are also a high value crop, representing an investment of about US $1,000 per hectare; again, fortunately they are not subject to significant damage except in the first three years of growth. However, in 1981, mechanical damage by buffalo caused costs of about US $300 per kilometer of front, twice the cost of damage to small holder maize.

Small holder maize is the main damage target, but is a crop of relatively low unit value, rarely above US $200 per hectare and usually much less. The value of the maize crop at risk varies in relation to landscape situation, more fertile valley areas supporting more valuable crops, both because farmers tend to plant larger gardens, and because crop quality is higher. Even so the cost of damage rarely exceeds US $150 per kilometer of front. However, this figure does not give a true picture of the cost to the individual farmer. In 1981, the average loss sustained by 178 small holdings was one bag of maize, about US $10 at current costs. This is the equivalent of one month's food supply or about half a month's wage for a rural laborer. Heavily damaged farms lost up to 13 bags of maize, US $130 at current costs, that is, over half a year's wage and about a year's food supply.

h.   Costs of Crop Damage; Conclusions:

The preceding paragraphs make the point that the costs of crop damage are due to a combination of ecological and socio-economic factors. Farms on the front line of the interface between settlement and wilderness are subject to the highest risks, but certain wildlife species are capable of penetrating and living within settlement behind the interface. Within the interface, wildlife pressure is related to landform and habitat, as is the value of the crop, so that the cost of damage is landscape related. The choice of crop in high risk locations is a key factor and should be a basic feature of land use planning. Location of a vulnerable and valuable crop in such locations (i.e., sugar, seed maize, coffee, etc.) automatically produces intense conflicts between economic and conservation interests which always cost money to resolve and are often prejudicial to wildlife resources. The Malaysia FELDA case is a textbook example of this kind. The Linyangwa planners were fortunate in that, by chance rather than design of the planners, tobacco plants have their own very effective chemical defenses.

i.   Control Measures and Self-Defense by Small Holders:

Having summarized the patterns of crop damage, we can now go on to evaluate methods of wildlife control.

By far the oldest and most widespread form of wildlife control is self-defense by small holders, both as individuals defending gardens by means of watchmen, fires, noise (i.e., drums, gongs, dogs, etc.) by use of fences and bomas and by the use of weapons, and as communities by concentrating settlement and eliminating patches of wilderness habitat. Ford (1971) has emphasized the importance of clumped settlement patterns as a primary means of defense against wildlife in precolonial Africa, and has pointed out the devastation caused in the 19th century by fragmentation of settlement by wars and disease, allowing wilderness and its wildlife to penetrate formerly defended settlement. The importance of self-defense can hardly be overemphasized since it forms the basis of the distinction between settled and wilderness areas and of the man-animal interface.

In the Linyangwa area, the effectiveness of self-defense is indicated by the existence of a front line on the interface, which is due to the fact that refuge-requiring species (elephant, buffalo, eland, kudu, etc.) are rarely able to penetrate a line of defended farms. The following table summarizes the location of 80 maize plots damaged by elephants in 1981:

TABLE 3

THE LOCATION OF DAMAGED PLOTS: LINYANGWA, 1981

Location	Number Damaged	% Total Damaged
1. Front line proper	52	65
2. Reverse front	13	16
3. Stream gap	12	15
4. Other	3	4
TOTAL	80	100

Front line proper refers to gardens facing directly onto the national park. Reverse front refers to gardens facing away from the park boundary but which can be reached by rounding the settlement perimeter without passing through other farms. Stream gap refers to gardens behind the main front but facing onto stream lines which create gaps in the front. Other gardens are those in any other situation. This table makes the point that a line of defended small holdings is a very effective barrier to elephants. The same is true of most other refuge-requiring species. Elephants can take advantage of small gaps in the front, and the location of farms should be designed to reduce these to a minimum.

The next point is that different sectors of the community have different capacities for self-defense. Traditional farms without cash crops and occupied by large extended families suffered significantly less damage (0.23 bags of maize lost per hectare) than Linyangwa scheme small holdings, growing cash crops--tobacco--in addition to maize and usually occupied by immediate family and a few employees (1.23 bags per hectare lost). Similarly the police unit at Linyangwa village, occupied by salaried officers with small immediate families suffered relatively high damage (1.19 bags per hectare). The highest damage was suffered by an invalid living alone (2.93 bags per hectare) amounting to total destruction of his crop. The implication here is that self-defense capability depends on family size and motivation, those with small families, alternative income sources and labor intensive occupations being less motivated towards defense. This is significant when discussing the pros and cons of compensation for damage. Compensation reduces motivation to defend crops and may exaggerate the problem since undefended farms both themselves suffer more damage and allow elephants to penetrate to second line farms.

That undefended farms are transparent to wildlife is shown by the fact that front line farms tend to harvest early in order to remove their crops from risk. At this point they cease defense and elephant attack on gardens behind them immediately commences.

The costs to the small holder of self-defense are hard to estimate but are considerable. Defense can be dangerous and death and serious injury from elephant, buffalo, lion, etc., are regular occurrences. The greatest cost, however, is in time spent by man, woman and child guarding gardens, both by day and by night. In high risk areas, the whole family moves from the village to temporary houses in the gardens. The need for constant guarding of crops undoubtedly impairs efficiency in other tasks and encourages householders to keep family members at home rather than allowing them to attend school, find other jobs, etc.

j. Control Shooting:

Control shooting has been the standard method of wildlife control by government agencies throughout this century; as noted earlier, many conservation agencies originated as departments of elephant control. It is generally assumed that control shooting reduces crop damage rates by "teaching" animals not to raid gardens.

To my knowledge this assumption has never been tested; it is not, indeed, easy to test, since to do so thoroughly would require control areas without shooting which would be unacceptable politically, while the variations in damage in time and space due to other factors makes isolation of the effect of control shooting difficult.

To investigate the question at Linyangwa, data from a block of 38 adjacent front line farms were examined in the highest risk sector of front (Block 1) to see whether the presence of control hunters for different numbers of nights per season, or the wounding or killing of elephants in a plot could be related to damage rates. The data are shown in the following tables:

TABLE 4

RATES OF CROP DAMAGE BY ELEPHANTS (IN BAGS OF MAIZE PER PLOT) IN BLOCK 1 FRONT LINE PLOTS AT DIFFERENT LEVELS OF GUARDING BY CROP PROTECTION HUNTERS:

	All Plots	Number of Nights Guarded by Hunter			
		0	1 or more	3 or more	4 or more
Mean number of bags lost	2.62	2.77	2.37	1.95	2.85
Number of plots	38	24	14	8	4
Standard error	2.99	3.37	2.18	2.46	3.22

TABLE 5

RATES OF CROP DAMAGE (IN BAGS OF MAIZE PER PLOT) IN BLOCK 1 FRONT LINE PLOTS, COMPARING PLOTS IN WHICH ELEPHANTS WERE KILLED AND WOUNDED WITH THOSE IN WHICH THEY WERE NOT:

| | All Plots | Number of Elephants Killed or Wounded | |
		Nil	1 or more
Average number of bags lost	2.62	2.92	1.34
Number of plots	38	31	7
Standard error	2.99	3.27	0.91

These data indicate no significant differences in crop damage rates between plots guarded by hunters, plots in which elephants were killed or wounded and plots with neither feature. Furthermore, Block 1 accounted for 47% (9) of elephants killed or wounded out of the total of 19 for the Linyangwa scheme as a whole. At the same time, Block 1 experienced 47.2% of damage in terms of cash loss.

I conclude that there is no clear indication that control shooting has reduced the value of the damage although it is impossible to say how much damage would have occurred had there been no control shooting. I conclude that the allocation of two to four hunter units to cover several hundred plots at risk results in too low a frequency of guarding to allow elephants to predict and thus avoid guarded farms. Since the density of hunter units in the Linyangwa area is well above average for rural Africa, my conclusion is that control shooting probably has very little influence in reducing rates of damage to crops.

The major tangible benefit of control shooting is, of course, the meat and trophies resulting from it. Between 1977 and 1982, an average of eight elephants per year were killed outright in the 29 km front of the Linyangwa scheme, in addition to three buffalo and three bushpigs and occasional monkeys and baboons. The meat from these animals is dried and sold locally at very cheap rates amounting to about US $0.10 per kilo of fresh meat, so that the amount collected for an elephant averages about US $100 from meat. This cheap meat serves an important public relations function and to some extent neutralizes the adverse public opinion directed at the national park. For the Department to take no action controlling wildlife and provide indirect compensation is politically unacceptable, and in the past, no alternative to control shooting was available.

In addition to the benefits to the public and the Department of Improved Public Relations, control shooting generates revenue for the department from the sale of meat and ivory (it has not been possible to recover usable skins under the conditions imposed by wildlife control hunting). The mean weight of ivory shot in the Linyangwa area has been 12 kg per elephant, giving at current prices about US $75 per kilo, that is, US $900 per elephant, averaging US $7,200 for the area per year. To this can be added ivory from a further three to five elephants recovered dead after wounding giving a further US $3,600 per year. With meat, therefore, the total revenue earned from elephants in the Linyangwa area therefore averages about US $11,600 per year. Together with the meat from other species, total revenue is about US $12,000 p.a., from the Linyangwa area. This usually amounts to about half the control shooting on the Kasungu National Park boundary, the total of which usually amounts to about US $25,000. In the context of the department as a whole, the total annual recurrent expenditure is usually around US $0.6 million, of which US $0.2 million is recovered as revenue. Of this revenue, the largest fraction (about 41%) comes from sales of ivory of which about half comes from crop protection shooting. Control shooting thus represents one of the largest single sources of revenue of the department, exceeding both tourism and sale of licenses (Clarke 1983). (Since 1982, revenue from control shooting has been overtaken by revenue from confiscated ivory.)

The costs of control shooting include the costs of maintaining the hunter units and the costs in mortality to the conservation status of wildlife populations. The direct costs of keeping a hunter unit in the field (i.e., hunter plus porter, equipment, ammunition, allowances, etc.) are currently about US $1,500 p.a. Thus, the costs for the Linyangwa area, where an average of three hunter units has been stationed, have been about US $4,500 p.a. or US $225 per kilometer of front, giving a revenue cost ratio of 2.7:1, assuming no savings in damage prevented.

The cost to the wildlife population is best seen considering the elephant population of the park as a whole. The figures are summarized in the following table:

TABLE 6

TOTAL RECORDED ELEPHANT MORTALITY, KASUNGU NATIONAL PARK

	1977	1978	1979	1980	1981	1982	1983	1984
Poaching	16	15	26	35	55	29	7	7
Control shooting	19	22	5	15	19	16	13	11
Natural + Unknown	13	9	7	8	15	12	7	8
TOTAL	48	46	38	58	89	57	27	26
% of increment removed by control shooting	32%	37%	8%	25%	32%	22%	22%	15%

Assuming that the total population is about 800 and that the annual increment is about 8%, giving an absolute increment of about 64 elephants, it is likely that off-take was in excess of recruitment from 1980 to 1982 (assuming a proportion of mortality unrecorded). It can be seen that control shooting made a significant contribution to the excess of mortality over recruitment, especially in view of the fact that a proportion of the natural and unknown deaths is probably due to crop protection wounding. Note that the low figure for control shooting in 1979 was the result of a Departmental policy decision that turned out to be politically unacceptable since at that time no alternative was available. The decline in 1983 and 1984 is associated with the successful introduction of electrified fencing (see below).

In conclusion, there is little indication that control shooting is effective in reducing the costs of crop damage. The primary benefits are in providing cheap meat to the public and in improving public relations for the department as well as earning revenue for the department and, by mis-appropriation, for individual officers. For these reasons, control shooting has always tended to concentrate on the larger, more valuable species such as elephant and buffalo, rather than the smaller, less valuable species (bushpig, monkey, baboon, etc.) which countrywide and even locally cause as much or more damage than the former. Control shooting can contribute significantly to the excess of mortality over recruitment of wildlife populations and historically has been important in eliminating wildlife in the man-animal interface and allowing expansion of settlements.

k. Chemical Deterrents:

From 1978 to 1982, trials were carried out with the chemical deterrent HATE 4c extract, manufactured by Celemerck Agricultural and Veterinary Chemicals. Initial impressions were favorable; elephants clearly dislike the scent and initially avoided areas to which it had been applied. Quantitative trials were carried out in the Linyangwa area, again using Block 1 front line farms. HATE 4c extract was sprayed by backpack spray around plot peripheries at the recommended dosage (1:250 extract: water). During the rains, each treated garden was sprayed at approximately two week intervals. The results are shown in the following table:

TABLE 7

COMPARISON OF DAMAGE CLASSES IN PLOTS TREATED WITH HATE 4C EXTRACT

	Number of plots per damage class			TOTAL	Percent plots per damage class		
	Very Slight	Slight	Med.		Very Slight	Slight	Med.
Treated	6	6	4	16	37.5	37.5	25.0
Untreated	7	5	1	13	53.8	38.5	7.7
TOTAL	13	11	5	29	44.8	37.9	17.2

This table shows that plots treated with HATE 4c experienced somewhat heavier damage than the untreated plots. While this may be due to a tendency to give priority for treatment to plots in high risk locations, it is clear that no worthwhile protection was achieved.

This is particularly true when costs are considered. The cost of treatment per plot over a four-month season was estimated at about US $10, that is, the same as the mean cost of damage over the study area. For HATE 4c to be cost effective, therefore, it would have to be 100% effective overall. There is no indication whatever that this is likely to be the case.

Application of HATE 4c had some slight public relations value, but was not regarded as a substitute for control shooting. We concluded that the method had little to recommend it, and it was abandoned.

1. Plantation of Exotic Fuel Woods:

In a project submission to the African Development Bank (Anstey 1979), the suggestion was made that plantations of exotic fuel woods, i.e., Blue Gums (*Eucalyptus sps*) might act as wildlife barriers by creating belts of unattractive habitat. This idea has been questioned by Bell (1979b), while Mr. David May reports (pers. comm.) that *Eucalyptus* plantations suffered serious damage from wildlife, particularly buffalo, in the Ngorongoro

serious damage from wildlife, particularly buffalo, in the Ngorongoro Crater Highlands, Tanzania.

In 1980, KFCTA planted 190 hectares of *Eucalyptus camaldulensis* on the boundary of Kasungu National Park in front of the Linyangwa scheme block 1. This was ideally placed to act as a trial of the suggestion that blue gums could act as a wildlife barrier. To test the suggestion, the damage rate of the plots covered by the plantation was compared with that of adjacent uncovered front line plots. The four plots covered received a mean of 1.5 bags of maize damaged, compared to a mean of 2.73 bags per plot for the block as a whole, with the damage rate decreasing towards the southern end covered by the plantation. These figures indicate that blue gum plantations are virtually transparent to elephant and buffalo.

At the same time, as indicated earlier, blue gums themselves suffered damage of twice the value of the maize gardens in that sector of front, giving a negative benefit:cost ratio even ignoring the high development costs. We conclude that blue gum plantations have no value as wildlife barriers, while they may place a substantial investment at risk. We recommend that such plantations should not be developed adjacent to wilderness areas unless effective physical barriers are installed to protect them in their early growth phases.

m.   Conventional Fencing and Ditching:

The pros and cons of conventional fencing and ditching were investigated in relation to the Linyangwa area, but no actual construction was carried out. We concluded that no conventional fencing is likely to be entirely effective against elephants, while costs would be prohibitively high (i.e., around US $15,000 per kilometer with maintenance costs). Equally we concluded that the sandy soils with many seasonal marshes are unsuitable for ditching. This control method was therefore not attempted.

n.   Electrified Fencing:

To my knowledge, the first use of second generation electrified fencing with large wildlife was the Malaysian FELDA trial in 1978 which has since been extended to cover much of the FELDA plantations. Similar fencing has been used on various estates and game ranches in Kenya and in 1983 was introduced on the southern boundary of Kruger National Park, South Africa. In all cases it has been relatively successful as a barrier against large herbivores.

In 1982, a trial 8 km of electrified fence was erected in front of Block 1 of the Linyangwa area. The majority of the fence consists of six "live" strands and one "earth" strand of 2.5 mm gauge high tensile galvanized wire supported by 1.5 m treated gum poles at 20 m intervals, using commercial insulators the upper two live strands being held on steel rod outriggers. The energizer is a model SP 50 manufactured by Gallagher, Frankton, Hamilton, New Zealand, using a 12-volt car battery charged by a solar panel. The voltage is about 4,000-6,000 volts in a pulse of 45-55 pulses per minute. This energizer system is, in fact, capable of powering up to 30 km of fence line. The cost of the 8 km of fence was Malawi kwacha 35,000 or Mk 4,300 per kilometer in 1982. This would be about US $4,000/km

at current prices. The fence was designed and construction supervised by a consultant from Kenya.

As a barrier, the electric fence has proved extremely effective. Table 2 shows that since its inception (1983 growing season) damage by refuge-requiring species (elephant, buffalo, kudu, eland) has been virtually eliminated except at the extreme ends where animals have rounded the fence. Damage by species not requiring refuges (i.e., bushpig) has not been affected since these species live outside the fence.

Observations on the trial fence at Linyangwa and trial exclosures using similar equipment (Gallagher E12 energizer) within the national park, indicate that elephants rapidly learn to avoid touching the fence, usually requiring only one or two contacts as training. No direct observations have been made with other species, but my guess is that they learn more slowly.   However, during a three week period in which the fence was inactivated by lightning strike after seven months of operation, only one minor fence break occurred.

During normal running, the electric fence requires regular inspection and maintenance, to repair minor damage caused by animals tearing wires off insulators while trying to jump it, etc., to cut vegetation touching the live wires and to repair mechanical faults. The fence is inspected two to three times per week and an inspection report filed. Each post is numbered and voltages, damage, etc., are referred to the nearest post. The cost of inspection and maintenance (including spares) is currently about US $200 per kilometer.

The cost of the trial fence (US $4,000/km) was high compared to the US $1,000/km of the Malaysian FELDA fence (Blair and Noor 1979).   Experience with the Linyangwa fence and subsequent trials has shown that the Linyangwa fence is overspecified and costs can be considerably reduced to about US $800/km, the major cost being the cost of wire.

The details of the design depend on the exact purpose.   In the Linyangwa situation, the objective is to contain elephants and buffalo (the two main refuge-requiring species causing damage) within the park.   This objective requires no more than four strands, as follows:

2.00 m above ground level - lightning earth

1.50 m above ground level - live wire

0.75 m above ground level - live wire

0.30 m above ground level - energizer earth

Elephants alone can be contained with only two strands, i.e., a live wire and an energizer earth at about 1.5-2.0 m a.g.l.   This is, in fact, the easiest species to contain since elephants can neither jump, crawl or dig, and young will not separate from parents (i.e., by going under the wires alone).

If the purpose is to exclude small animals such as bushpig and kudu as well from individual gardens, then up to ten strands may be required, thus considerably increasing installation costs. When constructing such fences it is necessary to decide whether this extra cost is really required.

Further savings can be made by using live trees instead of treated poles to support the fence. This has many advantages as follows:

(i)   The cost of clearing the fence line is reduced;

(ii)   Live trees are much longer lasting than treated poles, being resistant to termites and fire; and

(iii)   Live trees suppress grass growth and, hence, reduce maintenance costs.

Savings can also be made on insulation. Commercial insulators cost about US $1.00 each. We have successfully used short pieces of old plastic hose pipe stapled onto the pole, while Blair and Noor (1979) found that some tropical hardwoods are self-insulating and do not require any insulators. Trials should be made with African hardwoods such as *Terminalia*, *Colophospermum*, *Combretum*, etc., to test this possibility.

The second generation of electric fences appears to provide effective and relatively flexible barriers to large herbivores. Fence design and costs depends on the type of animals to be controlled, the megaherbivores being on the whole the cheapest and easiest to control. Elephants can be effectively controlled for no more than US $1,000 per kilometer installation costs, depending on the local price of materials and labor, plus US $200/km per year maintenance costs. Given a life of ten years to replacement, this gives US $300/km/year direct costs.

In the Linyangwa area, the maximum damage by elephants was recorded in 1983 at 245 bags of maize, valued at US $2,450 over a 20 km front, giving a loss of US $122.5 per kilometer. This gives a benefit cost ratio of 1:2.4 in direct financial terms and it is, therefore, not possible to justify electric fencing in this situation in terms of such a simplistic financial equation. (Obviously, this would be possible where a high value crop such as sugar or oil palm was involved.) Other factors to be considered were listed in Section 4 above.

Public opinion: In a recent public opinion survey, 125 front line small holders were questioned on their attitudes towards the electric fence. To the question: "Is the fence effective in reducing damage?" 42% replied that it is very effective; 42% replied that it is effective in the area it covers (block 1); the remaining 16% were uncertain. To the question: "Would you like to see the fence extended?" 93% replied affirmatively; 7% were uncertain; none replied in the negative. To the question: "Is the fence more effective than crop protection hunting?" 86% said that the fence is more effective; 8% said they did not know; 4% said it was best to have both; and 2% said they preferred hunting.

KFCTA has agreed to cover half of the maintenance costs, while farmers in other areas have begun to demand extension of the fence to cover their

small holdings. Information about the fence has been used very effectively in reply to hostile questions in parliament and other political fora. It is hard to assess whether this favorable public reaction has led to any reduction in political pressure on the park or in illegal activity. Certainly the Linyangwa sector of boundary has experienced relatively low illegal activity (see Bell, Chapter 21, this volume), but this may be for other reasons. The fence itself may act as a slight deterrent to illegal entrants, but represents a considerable investment at risk to those seriously ill-disposed towards the park, and the prospect of vandalism or theft of wire cannot be ruled out. Certainly, the fence has not yet led to any reduction in expenditure on public relations or law enforcement although expenditure on conventional wildlife control has been reduced.

The ecological effect of fencing is that the drain caused by control shooting is reduced. The reduction in control shooting associated with the fence can be seen in Table 6. As emphasized by Owen-Smith (1983 and in press), the prevention of dispersal of large herbivores may lead to over-population problems within conservation areas. This means that control shooting may have to be substituted by some other form of controlled off-take. This may mean that the population may increase towards or beyond ecological carrying capacity, or that an equivalent off-take in some other form may be allowed, either by tolerating a higher level of illegal off-take, or by some form of culling or licensed hunting program. In the latter case, it is important to note that, although the revenue from control shooting is reduced by electric fencing, the alternative forms of off-take are usually capable of earning considerably higher revenue, either by more efficient use of perishable products such as meat and skin, or through sale of hunting licenses. Effective decoupling of settlement and wilderness and, hence, of control and utilization, therefore, allow a more rational and economic use of wildlife resources, and would be the key factor in such integrated land use schemes as operation CAMPFIRE (see Chapter 20, this volume). The precise location of the fence in relation to settlement and marginal wilderness areas is important and will be discussed in relation to overall land use and wildlife control strategies.

o. **The Linyangwa Case Study--Conclusions:**

From this case study, we conclude that there are six methods of wildlife control of general significance in this type of situation, as follows:

(i)   Self-defense of crops by internal secondary chemical defenses. Some crops, such as tobacco, are largely immune from large mammal attack. In high risk areas, such crops have obvious advantages although they do not themselves constitute wildlife barriers. The appropriate choice of crop, taking into account both vulnerability and value in relation to damage risk is an important aspect of land use planning.

(ii)   Self-defense by farmers; this is the oldest and most widespread form of wildlife control, although it carries considerable social and economic costs. Where conservation agencies cannot provide alternative means of control, they

should recognize and encourage self-defense measures. Compensation for crop damage is not recommended, however, since it discourages self-defense and may exaggerate the damage problem. Consolidation of settlements, clearing of pockets of wildlife habitat and elimination of nuisance animals is an important aspect of community self-defense.

(iii)   Elimination of nuisance wildlife within settled areas; elimination from within settled areas of nuisance wildlife of the group not requiring refuges (i.e., bushpig, baboon, leopard, hippo, crocodile) is the long-term solution to damage by these species, which overall probably cause the highest proportion of damage to life and property. This requires a combination of consolidation of settlement, elimination of habitat pockets, self-defense activities (i.e., trapping bushpigs) and specialized assistance (i.e., shooting baboons, trapping leopards, etc.)

(iv)   Control shooting in the front line interface; this control measure of marginal value in reducing damage rates serves an important public relations role where no alternative control methods are available. It constitutes a form of wildlife utilization, albeit inefficient, that may generate revenue for the conservation agency and provide cheap meat for the local public.

(v)   Electric fencing provides an effective and cheap (relative to conventional fencing) barrier to large herbivores, particularly elephants. It can largely eliminate damage due to refuge-requiring species if constructed on the interface or by all species if constructed around gardens with the associated improvement of public relations. It requires proficient inspection and maintenance. It allows the juxtaposition of settlement and wildlife communities so that the inefficient off-take by control shooting may be substituted by more efficient and economical off-take methods.

(vi)   In the Linyangwa area, the effect of illegal hunting in the north and west of the elephants' range has been a major determinant of damage rates by elephants, so that law enforcement has indirectly been an effective wildlife control measure. It is, perhaps, questionable whether this situation has general application, but it would always be worth checking in a situation where heavy illegal activity occurs. The Luangwa Valley is a possible case, where most poaching pressure is on the west (park) bank, possibly causing elephants to spend more time on the east (settled) bank, thus increasing damage to crops in these areas.

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9.   WILDLIFE CONTROL AND LAND USE STRATEGY:

Wildlife control is an inseparable part of the overall land use strategy. In relation to all large wildlife species, each country needs to develop an overall management plan which asks the question (cf., Bell 1984b):

How many animals do we want?

Where do we want them?

How do we want to use them?

There are four basic forms of use to which wildlife can be put: preservation, sustained harvesting, ranching and elimination. Each of these forms of use is appropriate for each wildlife species to a particular land use zone of each country. Wildlife control is required to maintain the density gradients implied by such a land use strategy.

The planning of settlement patterns and the location of crop types on the basis of productivity, vulnerability and value is clearly basic to any such strategy. Another aspect is the decision as to where certain nuisance species should be eliminated. This refers to such species as bushpig, baboons, leopard, hyaena, crocodile and hippo.

On the question of maintaining wildlife density gradients on land use zone boundaries, the main choice is between control shooting and electric fencing. It seems to me that the introduction of the new generation of solar-powered electric fencing has radically transformed this aspect of land use planning in introducing a relatively cheap, effective and flexible barrier to large mammals. It means that density gradients can be much steeper than formerly, with advantage being taken of high wildlife biomasses right up to settlement boundaries, with no need for wide graded density buffer zones maintained by hunting and disturbance. It also means that the inefficient off-take under control conditions can be replaced if necessary by off-take by culling, licensed hunting or "legalized poaching" which are more efficient economically, generating greater benefits for the same off-take. Alternatively, if the zone objective is preservation, the population drain due to interface conflicts is reduced.

I anticipate that integrated land use planning of this type, in which wildlife control is used to effect a significant reduction in the conflict at the man-animal interface and to allow a more flexible and efficient approach to wildlife utilization, will reduce the problems and costs of conservation and ultimately lead to the easier achievement of priority conservation objectives.

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CHAPTER 25

WILDLIFE CONTROL IN MALAWI

BY

H. NSANJAMA

1. BACKGROUND:

a. Wildlife control is the term commonly used by the Department of National Parks and Wildlife. In very broad terms it refers to control activities mostly of mammals of vervet monkey size and up that destroy crops, livestock and human life.

b. Wild animal control has been a phenomenon of wildlife management in Malawi since formal conservation in 1947. It would appear that the earliest report of the Department of Game, Fish and Tsetse control put more emphasis upon control rather than conservation. From 1949 to 1952, the Department killed thousands of mammals and crocodiles each year. In 1953, there was a shift of policy. The Department only concentrated on dangerous game and left control of vermin (bushpig, baboons and vervet monkeys) to farmers. Later, most control took place within the vicinity of game reserves. By 1957, there were more conservation development activities and control work became less and less.

c. In 1959, a trial electrified fence was erected on the shores of Lake Malombe to protect rice fields from hippopotamus. The following year the fence was abandoned due to political pressure. Electrified fence was tried again in Southern Region where it was reported to have been a successful pig control device.

d. Throughout this period, a bounty program was in force, the purpose of which was to stimulate farmers into controlling vermin. As early as 1956, the results of this program were being rated disappointing because of apathy on the part of the farmers. The rewards were increased several times in order to make it attractive to the farmers, yet results were still very disappointing. Payments of reward ended in 1962.

e. The Department of Game, Fish and Tsetse control was dissolved at the end of 1962 and the function of wildlife management was assumed by the new Department of Forestry and Game.

During the periods of active wildlife conservation development of the 1960s and 1970s, wild animal control seems to have been folded.

f. The Department of National Parks and Wildlife was established in 1973. The Crop Protection Unit was reestablished in 1975. The purpose of the unit was to assist in agriculture development projects and to advise farmers generally on methods of crop protection from wild animals.

2. OPERATIVES AND OBJECTIVES:

a. The objective of wild animal control is to minimize the adverse impact of interaction between wild animals and people. To achieve that, the following modes of operation are undertaken:

(i)   **Planning and managing crop and livestock husbandry so as to minimize wild animal/human conflicts:**

- planning settlement so that it presents a solid front to wildlands:

- clearing intervening bush to reduce habitat between fields and paddocks; and

- controlling weeds in cultivation and regrowth on fallow.

(ii) **Repulsion:**

- applying chemical repellents; and

- using scaring devices.

(iii) **Physical barriers:**

- electric fencing;

- fencing livestock in paddocks;

- fencing gardens; and

- setting up nets to keep crops from birds.

(iv) **Elimination or reduction of numbers of pest species:**

- shooting;

- poisoning; and

- laying killer traps.

(v)   **Habitat destruction:**

- clearing forest or woodland; and

- draining wetlands.

(vi) **Removing specialized habitat:**

- destroying roosting/resting sites;

- destroying nests or nesting sites; and

- eliminating water holes.

b.   In Malawi, active control is undertaken by the government agency, particularly where specialized skills or technologies are needed. Members of the public are encouraged to participate. To secure

the public cooperation, the government sometimes offers rewards in exchange for tangible results or it may subsidize the costs of equipment and materials required for control.

c. Hunter scouts are accountable to the officers in charge of their units. In practice, the District Commissioners inform the hunters of the needs for their services. They act upon reports or call for assistance from the rural areas. Private individuals who have been or are being harassed by wild animals normally report to the nearest District Commissioner's office or the nearest police station.

Each hunting team is comprised of a hunter scout and a porter. It is equipped with a rifle (usually .458) and a 12-bore shotgun.

d. Operational instructions were originally for the units to concentrate upon animals that are difficult or dangerous for the public to tackle, and to leave the smaller, nondangerous species for farmers to deal with. However, the Agriculture Development Divisions (ADD) asserted that the greatest economic impacts are caused by primates and bushpigs. They further asserted that the Department should not neglect the latter with the added justification that they (ADD) foot the greater part of the bill.

e. During the dry seasons, the units organize drives. They do so by organizing groups of villagers that range in numbers from 20 to 300. They are accompanied by dogs and all kinds of traditional weapons except guns. The drives are controlled by a departmental officer, and these usually are armed hunter scouts in attendance. These drives are reported to be very popular. Clearly, they provide opportunities for excitement and recreation; and there is the added incentive of meat for those communities that eat pigs and primates. Nevertheless, village communities fail to organize drives on their own accounts. Three possible reasons for this have been suggested:

   (i) An absence of will or ability to organize an operation of this type and magnitude;

   (ii) The prohibitive costs of ammunition; and

   (iii) Villagers fear that they may be placed in an ambiguous position should they or their dogs put up and kill nontarget species such as bushbuck or duiker.

   The presence of departmental officers at the drives is said to assure effective organization, provides free ammunition and give official blessing.

SECTION 4

EDUCATION AND PUBLIC RELATIONS

CHAPTER 26

<u>CONSERVATION EDUCATION</u>

BY

SANDRA PRICE

1.   INTRODUCTION:

The instructor invited to cover conservation education at the Lifupa Workshop was Ms. Sandra Price. Ms. Price made a presentation at the workshop, but has unfortunately been unable to provide a script so that we have compiled these notes incorporating material from her presentation.

2.   WHY IS CONSERVATION EDUCATION NECESSARY?

Conservation in its present form represents a radical departure from traditional patterns of land and resource use in Africa. While many societies had strong traditions of preserving certain components of their environments (such as religiously significant sites) and of sustained use of others (such as wildlife resources), the present pattern of government regulation of land and resource use is generally unfamiliar and often unpopular. It is perceived as curtailing individual liberties and conflicting with short-term economic interests. As we have emphasized earlier, conservation rests on a conflict between conservation objectives and popular aspirations; if this were not so, there would be no need for formal conservation. The problems and costs of conservation are proportional to the extent of the conflict.

The purpose of conservation education, then, is to facilitate the achievement of conservation goals by influencing public opinion in such a way as to reduce the conflict between conservation goals and public aspirations.

3.   POTENTIAL AUDIENCES:

The first step is to identify the various sectors of the public of which the opinion is to be influenced. This is necessary for several reasons. Firstly, each sector of the public has different opinions and interests, that is, each relates to conservation objectives in different ways; secondly, each sector must be reached in a particular way; all education methods are not equally appropriate to each sector; and thirdly, the message to be delivered to each sector may differ.

The sectors of the public identified at the workshop as target audiences for conservation education are listed below:

TABLE 1

TARGET AUDIENCES

Preschool
Primary schools
Secondary schools
Universities
Postgraduates
Teacher training colleges
Technical training institutes
Rural communities (near parks)
Rural communities (elsewhere)
In-school youth
Out-school youth
Newly literate
Self-help groups
Armed services

Politicians/decision makers
Traditional authorities
Radio owners
Civil servants
Industries
Trade unions
Tourists
Expatriates
Conservation professionals
Conservation societies
Women's groups
Parents
Religious groups
Youth groups

4. EDUCATION METHODS AND PUBLIC RELATIONS TECHNIQUES:

The education methods and public relations techniques identified at the workshop are listed in Table 2. Of this extensive range of alternatives, we may single out the following as being the most important methods:

Rural public   -   Public meetings
                         Slides/movies
                         Radio

Decision makers   -   Radio
                         Newspapers
                         Executive summaries
                         Seminars
                         Museums/information rooms

School attendees   -   School curricula
                         Clubs
                         Movies/slides

TABLE 2

EDUCATION METHODS AND PUBLIC RELATIONS TECHNIQUES

1	Wildlife clubs	28	Rallies
2	Magazines	29	National events (tree days, etc.)
3	Slides	30	Awards
4	Movies	31	Oral traditions
5	Television	32	Executive summaries
6	Radio	33	High level presentations
7	Newspapers	34	Research projects
8	Discussions	35	Zoos
9	Lectures	36	Camps
10	Field trips	37	Fund raising
11	Posters	38	Slogans/mottos/logos
12	Workshops	39	Role playing
13	Drama	40	Debates
14	Live animals	41	Discos
15	Demonstration projects	42	Videos
16	Music	43	Petitions
17	Poetry	44	Fraternization/bon voisonage
18	Dancing	45	Cultural traditions
19	Print handouts	46	Public meetings
20	Promotional products	47	Walks/marches/jogs
21	Seminars	48	Field courses
22	Development projects	49	School visits
23	Mobile units	50	Nature trails
24	Competitions	51	Puppet shows
25	Museums; information rooms	52	Skywriting
26	Natural history activities	53	Horse riding
27	Tourism	54	School curricula

In all cases, however, the most effective method is the visit to a conservation area where live animals can be seen in "natural" habitats. Zoos are also highly effective. We would suggest, therefore, that the most effective use of funds in the area of conservation education is in enabling visits by the various sectors of the public to conservation areas. This involves the provision of cheap accommodation in the form of hostels, transport (i.e., buses or lorries plus running costs), guides and food.

5. THE ISSUES:

The priority issues identified as subjects for conservation, education and public relations are listed in Table 3:

TABLE 3

PRIORITY ISSUES FOR CONSERVATION EDUCATION

Natural communities as life support systems
Resource exploitation
Conservation legislation
Soil erosion
Deforestation
Overgrazing
Human population pressure
Pollution
Extinction
Poaching/hunting
Energy requirements
Tourism
Urbanization
Water/catchments
The quality of life

Essentially, the issues presented will represent the value system of the agency controlling the education and public relations program. A criticism that can be levelled at some conservation education programs is that they embody Western value systems that are not always appropriate to African conditions. In particular, the relative emphasis placed on preservation and utilization should be carefully considered since, in the event of the conservation program proving successful, a public opinion heavily weighted towards preservation may constitute an obstacle to a balanced conservation program combining preservation, conservation and utilization.

To conclude, the content of a conservation education program is not necessarily intuitively self-evident. It must be related to the long-term conservation strategy for the country and should be an integral part of the conservation agency master plan. The content and emphasis of the education program must be designed to facilitate the long-term objectives of the conservation agency.

CHAPTER 27

THE ROLE OF THE ENVIRONMENTAL UNIT
OF THE DEPARTMENT OF NATIONAL PARKS AND WILDLIFE, MALAWI

BY

L.D. SEFU

1. INTRODUCTION:

In 1973, the Lilongwe Nature Sanctuary was developed as an Environmental Education Center under the Department of National Parks and Wildlife. Staff were drawn from the Environmental Education Unit set up earlier under the Land Husbandry Branch to work in secondary schools. In 1978 a second environmental education center was initiated at Michiru, Blantyre as part of an integrated land use project demonstrating multiple use management on a sustainable basis, the Michiru Mountain Conservation Area. To function effectively, these Environmental Education Centers required a background level of environmental education on a nationwide scale, so operation of the two centers was combined into a single Environmental Unit (now changed to Education and Information Unit). The Environmental Unit adopted the general Environmental Education Goals agreed by the UNESCO Tbilisi Conference (UNESCO 1977). Having assessed the level of knowledge of the environment in Malawi, the task of creating an awareness of environment and environmental principles was given first priority after which the other stages could follow (Hough 1981).

a. Goals:

(i)   To foster clear awareness of, and concern about, economic, social, political and ecological interdependence in urban and rural areas.

(ii) To provide every person with the opportunity to acquire the knowledge, values, attitudes, commitment and skills needed to protect and improve the environment.

(iii) To create new patterns of behavior of individuals, groups and society as a whole towards the environment.

b. Target Groups:

The target audience of the Environmental Unit is the entire population of Malawi, divided into four target groups:

(i)   **Leaders and Decision Makers**   -   ministers, executives, heads of government departments, etc.

(ii) **Formal Education**   -   teachers and students involved in any formal education.

(iii) **Urban Public**   -   primarily inhabitants of Lilongwe, Blantyre, Zomba and Mzuzu.

(iv) **Rural Public**   -   largely farm and village people, the bulk of Malawi's population.

Various well-established channels for communicating with these groups already exist (see Table 1). Consequently, the most straightforward method

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of educating these groups is to supply information through these existing channels. However, there are two important drawbacks to this otherwise efficient method:

(i)   Effectiveness of Communication Channel:

Once information is fed into one end of the channel, there is little or no control by the Environmental Unit and results are totally dependent on the effectiveness of that channel.

(ii)   Receptiveness of the Channel:

The operators of that communication channel may reject the information or that channel may be already overloaded and have no time or space available.

Hence, in addition to utilizing existing communication channels, the Environmental Unit has developed its own between it as the source and certain target groups as the recipients.

The different channels of communication require the environmental messages to be prepared in different forms. These forms depend both on the nature of the target group and on the resources available by way of staff, finance and equipment.

Considering the various target groups, possible channels of communication (both existing and potential) and the resources available to the Environmental Unit, a basic operational table was synthesized (Table 1).

c. Messages:

In view of the broad nature of environmental education and the need to first stimulate an awareness of basic environmental processes, the specific environmental messages put across vary widely. However, a number of priority areas have been identified:

    (i)   Trees as source of firewood and building poles;

    (ii)   Human population expansion;

    (iii)   Soil and water conservation and principles of their ecological cycles; and

    (iv)   Threatened habitats and biotic communities.

d. Present Teaching Methods:

Referring to Table 1, priorities in terms of target groups were first established, overlap in channels of communication and the form of information for the different groups identified, and then these were related to the available resources of the Environmental Unit.

TABLE 1

ENVIRONMENTAL UNIT TARGET GROUPS
AND COMMUNICATION CHANNELS

TARGET GROUP	COMMUNICATION CHANNEL	FORM OF INFORMATION
Leaders and Decision Makers	Seminars Media Exhibitions	Data Technical Papers
Formal Education	Curriculum Development Programs, Lectures, etc. Courses for teachers and students Wildlife Clubs	**Teaching Materials:** - Environmental Activities Manual - Resource Packs - Slide/Scrip Programs - Visual Aids - Newsletter for Wildlife Clubs
Urban Public	Media Exhibitions Wildlife Clubs	Popular Articles Posters, Photographs, Brochures and Booklets Radio Programs
Rural Public	Media Agricultural Extension	**Teaching Materials:** - Booklets - Visual Aids - Slide/Script Programs Radio Programs

One further influence applied to the operation of the unit is that since it is under the Department of National Parks and Wildlife, more time is spent on wildlife related topics than would be found in a pure environmental education program.

Clearly, the first priority for environmental education, in terms of what happens to the environment today and tomorrow, should be the leaders and decision makers but because these are a difficult group to approach greater emphasis has been placed on schools as a captive audience, tomorrow's decision makers.

In order of priority of allocation of Environmental Unit resources, the following work is at present undertaken:

(i) Wildlife Clubs:

An out-of-school environmental activity program for schools through organized clubs. Termly newsletters are produced containing news, information and ideas for environmental activities. Training courses are organized for teachers and club leaders. Clubs are visited once every two years. At present, clubs are largely confined to secondary schools though some teachers, colleges and primary schools have just been started. Approximately 2,000 people are members of wildlife clubs.

(ii) Schools:

All secondary schools in the country receive a lecture visit once every two years. Primary schools are visited on request. Visits are organized to the regional Environmental Education Centers, Lilongwe Nature Sanctuary and Michiru Mountain Conservation Area, and various national parks. A student hostel for overnight accommodation exists at Lengwe National Park and a student camp has been constructed at Kasungu National Park. A set of wall charts and explanatory booklets on Malawi's Mammals has been produced and other educational aids are planned. Slide/script packages could easily be produced but their use is at present limited by the few schools possessing slide projectors.

(iii) Newspaper Column:

A weekly newspaper column aimed at the literate urban public and leaders and decision makers was started in 1983. Its appeal and effectiveness is as yet unknown.

(iv) Urban Public:

Displays, information services and special environmental programs are available at the Lilongwe Nature Sanctuary and will soon be available at Michiru Mountain Conservation Area. Special exhibits on the environment are prepared for agricultural shows, trade fairs and party conventions.

(v)   National Park Visitors:

Interpretive services to explain wildlife and its management through booklets and displays are provided to national park visitors.   Training courses are run for staff on interpretive duties.

(vi)   Seminars, Conferences, Courses:

The Environmental Unit has actively participated in organizing various workshops and seminars for teachers and top government officials.

(vii)   Rural Public Around Protected Areas:

Extension programs are arranged for the rural public living immediately around national parks, game reserves and similar areas.   Campaigns have been conducted for Michiru Mountain Conservation Area, Kasungu National Park and Nyika National Park.

(viii)   Environmental Resource Centers for Teachers, Urban Public, etc.:

A library and resource materials on the environment are maintained for public use at the Lilongwe Nature Sanctuary and Michiru.   A new post of Resource Production Officer has been established at the Lilongwe Nature Sanctuary.

e.   Evaluation:

The major shortcoming at present is the lack of a direct active communication system to the leaders and decision makers.   Exhibitions and displays are passive and their information content is necessarily limited by size and duration.   The "Sam Chire" newspaper column has considerable potential though it is still indirect.   Greater emphasis is being given to this group since despite the small number of people involved, they are in key positions for affecting the quality of the environment immediately.

Students are the easiest target group to deal with, which is why they receive most attention at present through the wildlife club system and school visits.   The present wildlife club system is limited as it is only just being expanded into primary schools, though the methods are fairly well worked out and tested.   The main need is for the planned Environmental Activities Manual.

Many clubs exist in name only and a manual and further teachers courses will encourage them to be more active.   Servicing of additional clubs will become a problem as staff time and resources are already close to their limits.   Postschool wildlife clubs are also being encouraged and have considerable potential if all ex-school club members join.

Lecture visits to schools are limited in effectiveness though a single message can normally be communicated.   Every secondary school students should thus have received two messages by the time they leave.   Resources prohibit any formal system of primary school visits.

School curriculum development and associated teacher training, particularly at the primary level, offer much potential, though these are dependent on educating the educational decision makers first.

Though work with schools is of vital importance for the future, the results of such education will only become apparent in the future and such work does virtually nothing for present environmental problems.

Education of the rural public is being given low priority as the logistics for reaching them are being explored with the Health and Agricultural Extension Systems who have a large influence with rural communities through their popular shows.

Since a major part of the Environmental Unit is collection, synthesis and reproduction of environmental information, the information and data collection system, storage and retrieval is of major importance. At present, it is limited and though improving slowly will remain a weakness for some time yet.

2. CONCLUSION:

The Environmental Unit has so far directed most of its energies towards the secondary school population and methods and techniques for environmental education at this level have been proven and tested. This work is now being expanded into primary schools and colleges, the limiting factor being the staff time and resources available to the unit. Since educating the school population is planning for the future, attention must be paid to the leaders and decision makers of today. Without their awareness and action on environmental problems today, it will be too late by tomorrow. The leaders and decision makers are a difficult group to deal with directly but it is this challenge which is now being taken up by the Unit.

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CHAPTER 28

MONITORING OF PUBLIC ATTITUDES

BY

R.H.V. BELL

1. INTRODUCTION:

Public attitudes are a key factor in conservation and wildlife management since the success of these activities ultimately depends on the consent of the public and the government. The problems and costs of conservation are proportional to the extent to which conservation goals conflict with short-term popular interests. A conservation agency, therefore, has two tasks in relation to public attitudes, firstly to influence them (see Chapters 28 and 29), and secondly to monitor them in order to determine whether its programs are influencing public attitudes in the manner intended. Monitoring of public attitudes therefore provides the adaptive management feedback channel in one of the most important areas of conservation activity.

In spite of its key role, public opinion monitoring has tended to be neglected in the past, partly, as will be seen, because of the inherent methodological difficulties involved. We argue, however, that it is essential that the importance of this type of monitoring should be recognized, that it should be built into all management programs where relevant, and that special efforts should be made to overcome the methodological difficulties.

2. METHODS OF MONITORING OF PUBLIC ATTITUDES:

Monitoring of public attitudes towards conservation and wildlife management in Africa has certain inherent difficulties, firstly because many of the communities involved are unsophisticated and geographically inaccessible, and secondly because they frequently perceive their own attitudes towards wildlife to be at variance with official attitudes, so that genuine opinions may not be freely expressed. Overt opinion polling is thus normally effective only on topics that are politically and legally neutral.

There are six main approaches to the monitoring of public attitudes in these circumstances, as follows:

a. Standard polling on neutral topics;

b. Incognito injury by members of the conservation agency;

c. Sociological surveys by workers not overtly connected with the conservation agency;

d. Inquiry by means of the local leadership hierarchy;

e. Establishment of relations of mutual trust between local communities and conservation agency staff; and

f. Inference of attitudes from activity patterns, i.e., monitoring of illegal activity.

Each approach is more or less appropriate in a given situation, and where possible a variety of approaches should be attempted, to provide opportunities of cross-checking.

With each approach, particular problems of sampling and bias arise. Most methods are still in their infancy, and particular attention needs to be paid to sampling strategies. In most situations, it is necessary to stratify the population being sampled, both in relation to the socio-economic situation, and in relation to geographical location. It is also necessary to anticipate that the degree of bias, both in the probability of obtaining information and in the probability of the information being genuine, is likely to vary between strata.

The approaches to public opinion monitoring are summarized in the following paragraphs. Our object is to emphasize the preliminary nature of research in this area to date, and to encourage improvements where possible.

3.   STANDARD POLLING ON NEUTRAL TOPICS:

Standard questionnaire surveys on more or less neutral topics have been carried out on a wide range of questions related to African conservation. They have most commonly aimed at literate target populations, particularly in respect of opinions and activities of tourists (e.g., Carter 1985), and market research in relation to tourist developments. The greatest difficulty with most such tourism surveys is that they usually sample only that small sector of the public which actually visits conservation areas, that is, the surveys are conducted at tourist destinations. This automatically introduces a substantial bias into data relating to motives for visiting or not visiting conservation areas.

Probably the most extensive public opinion polling survey ever carried out on African rural populations in relation to natural resources was the survey carried out by Watson, Tippett, Rizik and Scholes (unpublished data) in conjunction with the Sudanese Veterinary Department, in the course of the Sudan National Livestock Inventory Survey in 1974-1976. Here, thousands of households were questioned countrywide on a range of issues relating to livestock, agriculture and wildlife resources. The survey was carried out by stratified random sampling: each province was stratified for aerial census of livestock, agriculture and wildlife; within each stratum, a sampling density was chosen in relation to livestock density and sampling locations were chosen by means of pairs of random coordinates (see Jolly 1969, method 3); the survey team then visited each sampling location and interviewed the householder found nearest to that point.

4.   INCOGNITO INQUIRY BY MEMBERS OF THE CONSERVATION AGENCY:

Prime topics for inquiry are public attitudes towards government conservation measures and illegal use of wildlife resources. For obvious reasons, it is difficult to obtain reliable information on these topics by overt inquiry.

We are aware of a number of surveys of these topics that have been conducted by conservation agency staff working incognito, for example, one in Zimbabwe (Cumming, pers. comm.) and one in Malawi around Lengwe National Park (Munthali, Banda and Bell, unpublished data).

In the Malawi case, the population surrounding Lengwe National Park was stratified firstly into socio-economic strata, as follows:

Subsistence farmers;

Cash crop farmers;

Estate workers;

Estate management;

Village headmen;

Local government officials;

Traders, general;

Traders, butchers; and

Restaurant owners.

A second dimension stratification was imposed by dividing the area into zones of different distance from the boundary of the national park, each representing a band of 5 km width. Within each zone, sampling locations were selected by a randomization process as in the Sudan survey. The staff conducting the survey travelled in plain clothes in a government vehicle; their apparent identity was of agricultural extension workers conducting a survey of agricultural practices. They conducted the interviews casually as if in ordinary conversation, memorizing the replies. On completing an interview, which could last over an hour, they drove to a secluded spot and completed the written questionnaire for each interview. It was found that using this format, interviewees were freely critical of government conservation policies (perceiving the interviewers as not directly concerned), but were cautious about describing illegal activity. Similar results were obtained in Zimbabwe (Cumming, pers. comm.)

We have found that it is possible to obtain detailed information on illegal activity when posing as participants (i.e., as illegal ivory buyer). However, this method imposes severe constraints as to both sample size and randomization.

5. SOCIOLOGICAL SURVEYS BY WORKERS NOT OVERTLY CONNECTED WITH THE CONSERVATION AGENCY:

This is probably the most effective means of obtaining in-depth reliable information concerning public attitudes towards conservation among rural communities. The ideal is the classic study by Marks (1975) of the sociology of hunting by the valley Bisa in the Luangwa Valley, Zambia. Similar studies relating to the use of wildlife resources by rural African

populations have been carried out by Murray (1980) with the Kalahari Bushmen, by Turnbull (1961 and 1973) with the Ituri pygmies and Uganda Ik, respectively, and currently by Reynolds (pers. comm.) concerning the valley Tonga in the Omey area, Zimbabwe. These workers have pursued the standard approach of social anthropology of living with a selected rural community and being accepted by it over a number of years.

The quality of the information so derived is very high; however, the approach has the unavoidable limitation that it is intensive rather than extensive; it takes a long time, covers a small area and requires a particularly dedicated type of field worker. As a result, few such studies have been carried out and it would be highly desirable to encourage more.

A further difficulty with this approach is that the success of any such socio-anthropological survey depends largely on complete mutual trust between the researcher and the community. Communication between the sociologist and the conservation agency must, therefore, be limited and information used with great discretion. Marks (pers. comm.) maintained no formal contacts with the Zambian conservation authorities during his field study, and when away from his study area, always travelled with a community member who could monitor his movements and contacts, thus, maintaining community confidence in his good faith.

Kandawire (1981) carried out a relatively short-term sociological study of attitudes towards conservation in the Lower Shire Valley, Malawi, lasting several months and making use of university students to carry out field work. The study was relatively extensive and information of considerable value was collected, but informants were reluctant to provide details on illegal activity.

6. INQUIRY BY MEANS OF THE LOCAL LEADERSHIP HIERARCHY:

This technique is of particular value when the conservation agency is contemplating a specific management measure, such as a culling or utilization project, and wishes to assess the probable local reaction. This is both because the leadership hierarchy is specifically designed as the channel from the grass roots to the upper levels of government and also because the hierarchy is itself often important in formulating public opinion. This method can, therefore, be used as a means both of publicizing the agency's intentions and of eliciting a response to them. A major difficulty, however, is that the interests of the leadership hierarchy do not always correspond in detail with those of the grass roots. Nonetheless, it is important that they should be known and taken into consideration. The data collection is usually relatively simple and straightforward.

7. ESTABLISHMENT OF RELATIONS OF MUTUAL TRUST BETWEEN LOCAL COMMUNITIES AND CONSERVATION AGENCY STAFF:

This is, of course, an ideal situation to which most conservation workers aspire. However, it is rarely achieved since conservation objectives and local interests are often irreconcilably opposed. Successful use of this approach usually requires a rather profound change in outlook by conservation agency staff to the point where they are

prepared to enter into a genuine dialogue with local communities and to refrain from punitive measures if evidence of illegal activity emerges. The utilization schemes proposed in Chapter 20 (Project Campfire) and 21 (legalized poaching) are based on attempts to establish this kind of dialogue.

Perhaps, the most successful use of this approach is that by the Lupande Research Project in the Luangwa Valley, Zambia (Lewis, unpublished reports). Here the project, which is informally linked to the Zambian National Parks and Wildlife Service, has over several years established a dialogue with local communities over such issues as multiple land use planning and utilization of wildlife by culling, safari hunting and local licensed hunting.

8.   INFERENCE OF ATTITUDES FROM ACTIVITY PATTERNS:

"Deeds speak louder than words." An important source of information on public attitudes is the activity pattern of the communities in question. This is a standard approach in socio-anthropology, particularly in the analysis of resource use where people may not in fact conceptualize their attitudes and resource use strategies. In the case of the analysis of the use of wildlife resources, the method of monitoring of illegal activity (Chapter 22) can provide useful information on public attitudes in particular situations. It shows, for example, clearly distinct attitudes towards wildlife and conservation between subsistence communities and cash farmers.

9.   MONITORING OF PUBLIC ATTITUDES, CONCLUSIONS:

Since the success of conservation activity largely depends on public consent, influencing and monitoring of public attitudes are essential components of conservation. However, the monitoring of public attitudes has been generally neglected in conservation circles, firstly, because it is a difficult and time-consuming process; secondly, because it has less immediate appeal than classical ecological studies; and thirdly, perhaps because it frequently produces information that conservationists do not want to hear, namely that conservation is often unpopular.

This brings us to an important point; what is the correct response to evidence that conservation activity conflicts with local aspirations? This must be a profound question for any conservationist and has indeed led to extensive heart-searching, for example, in Graham's (1973) Gardeners of Eden.

My feeling is that we must recognize that those conflicts of attitude and objectives are based on subjective value judgements or aesthetic decisions (Bell 1983). Each conservation agency needs to spell out its value system in terms of a set of conservation objectives in order of priority. The monitoring of public attitudes will then provide the information on the extent to which these objectives conflict with local aspirations, and hence the likely problems and costs of achieving them. The agency can then plan a series of measures aimed at tracing the size of the conflict and it must monitor progress to see if the measures are having the desired effect. For example, utilization by safari hunting may

generate revenue for district authorities, but it may simultaneously make it more difficult to reach conservation objectives by generating adverse public opinion (cf., Lewis, unpublished reports).

Ultimately, however, there is likely to remain an irreconcilable residue of conflicting interests. The conservation agency should attempt to reduce these to a minimum consistent with its priority conservation objectives. Beyond this point, the agency should not plan by opinion poll; it must abide by its conviction that its objectives are in the best public interests in the long term.

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CHAPTER 29

WILDLIFE CONSERVATION AND MANAGEMENT IN MALAWI: FOR WHOM?

BY

J.N.B. MPHANDE

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1.   INTRODUCTION:

The Malawi Department of National Parks and Wildlife is charged with the responsibility of conserving and managing Malawi's wildlife resources as stipulated in the National Parks Act, Game Act and Wild Bird Protection Act. Laws of Malawi Chapters 66:07, 66:03 and 66:04, respectively. These conservation efforts are directed at benefiting the people of Malawi primarily, but also visitors to the country. The question I would like to address, is whether the majority of the people in Malawi do realize this fact or to put the question differently, what is/are the people's opinion(s) regarding wildlife conservation.

I will discuss the question under two broad categories. Wildlife resources outside protected areas and wildlife resources in protected areas.

2.   WILDLIFE RESOURCES OUTSIDE PROTECTED AREAS:

Wildlife resources outside protected areas are very limited and as such their use has to be controlled. The Game Act and Wild Bird Protection Act spell out the regulations regarding the use of these resources. Other acts relating to the conservation of wildlife resources outside protected areas are: the Forestry Act, the Fisheries Act, and the Crocodiles Act. Laws of Malawi Chapters 66:01, 66:05 and 66:06, respectively. But these Acts are under the charge of other departments.

Conservation of resources outside protected areas is achieved by granting different status to different species of both animals and plants, the use thereof being regulated through the issue of licenses and/or permits. There are three types of licenses: the *district license*, the *national license*, and the *minister's license*. Holders of these different licenses are entitled to shoot specified animals in specific quantities and in specified areas. The *district license* entitles the holder to shoot up to five common duikers and two warthogs. The license also restricts the holder to shoot the animals in a specified district. A holder of a *national license* is entitled to take two male bushbucks, up to two common duikers, two Sharpe's grysbucks, and two warthogs. The holder can shoot the animals in any district in the country. A *minister's license* which is issued upon the recommendation of the Chief Parks and Wildlife Officer is special in that it allows the holder to shoot animals that are otherwise protected. Examples are: cheetah, elephant, suni, leopard, lion, kudu, nyala and zebra, among others. The areas in which the *minister's license* is valid will also be specified. For animals that are classified as vermins, a license is not necessary. Examples of vermins are bushpigs, vervet monkeys, and baboons. Any number of vermins can be taken. In the Game Act, regulations regarding possession and sale of wildlife and their trophies are also spelt out in addition to the regulations already mentioned. If these regulations were effectively enforced, the use of resources outside protected areas would be controlled for the benefit of the peoples of Malawi and visitors to the country. The question of concern in this paper is how the people feel about these conservation efforts.

Most of Malawi's population is rural and engaged in subsistence farming. Historically, people in these communities have used hunting as a

means of supplementing their diets. Hunting also provided a form of sport engaged in during the dry season when most farm work is finished. There was no limit as to what could be shot and when it could be shot. There was no bag limit either. The methods of hunting were also at the discretion of the hunter. Therefore, the introduction of the acts designed to control the utilization of wildlife resources is in direct conflict with the tradition. It is without doubt that the people in the rural setting who are the majority, view these laws negatively. They are prohibited from using the methods they traditionally used. Hunting parties using bows and arrows are fun for the traditional hunter and yet this method is not allowed. About the only legal method of killing animals is by the use of a gun, an instrument that has only recently been introduced in the Malawian culture. Definitely, hunting using a gun will not provide the same satisfaction to a traditional hunter as would the use of bow and arrow or spear. Basically, what is happening is that the people are being forced into a new way of life and as is always the case adapting to change is a very slow process. What is needed is a concerted public relations effort to educate the public, particularly the people in the rural setting, about the importance of conservation. Once the principles are well understood, we will have won half the battle. The second half will be to make the people accept hunting with guns as a form of recreational hunting. Meanwhile, hunting with guns is associated with profit making. The hunter is out to recover the money he spent on the gun, ammunition and license. With this motive, the quotas on the licenses are normally overshot.

Another aspect that generates negative feelings is the fact that some wild animals will damage peoples' crops, be it farm crops or livestock. Since most of the population is rural and agricultural-based, such depredations are a great economic loss and evokes a lot of negative feelings. If farm lands were fenced off, then wild animals would be an added asset. But most farm lands are unfenced, hence the only way of ensuring safety of the crops on a long-term basis is elimination of wildlife species depredating on the crops from the immediate vicinity of farm lands. A temporary measure is guarding of the crops, i.e., constantly chase away invading animals, a form of life which is not very pleasant. To sum up, while the conservation movement is for utilizing the wildlife resources on the farm lands on a sustained yield basis, this form of land use is in direct conflict with the present agricultural practices. Until and unless farm lands are fenced to minimize crop depredations, the people's feeling will be negative.

3.   **WILDLIFE RESOURCES IN PROTECTED AREAS:**

The Game Act provides for the creation of game reserves, while the National Parks Act provides for the creation of national parks. There are four game reserves and five national parks in Malawi. The main objective of setting aside these areas is to preserve representative biotic communities of Malawi in a relatively undisturbed state. The policy is to keep things as natural as possible, i.e., man's interference should be kept to a minimum. How do the people look at these protected areas? As I have already mentioned, the majority of Malawi's population is rural and based on subsistence farming.

With the increase in population, the problem of finding suitable land for cultivation is becoming acute. Therefore, most people view game reserves and national parks as lands lying in waste. They would rather have them opened up for agriculture. This type of feeling has led to a lot of deliberate encroachments in the form of cultivation. In the Shire Valley Wildlife Range, all three areas, i.e., Lengwe National Park, Majete Game Reserve and Mwabvi Game Reserve, have experienced this problem.

Another source of negative feelings is the fact that, to the people, there are many resources in these areas which are not being utilized. Cases in point are firewood, poles for construction, timber, honey, game meat and wildlife trophies, among others. Most people do not appreciate the importance of conserving these resources and some go to the extent of taking their share illegally.

Yet another aspect of negative feeling arises from the fact that these areas are a sanctuary of wild animals that depredate the people's crops. The people feel if these areas were abandoned, then the crop depredation problem would be permanently solved.

Here too, just as in the case of wildlife conservation outside protected areas, the opinion of the majority is negative. Efforts have to be made to try and change these attitudes.

4.   THE MAJORITY OPINION; CAN IT BE CHANGED?

In the foregoing paragraphs, I have concluded that the majority opinion towards wildlife conservation is negative. This feeling is a result of the public only being aware of the negative attributes of wildlife conservation: nonconsumptive uses of resources, harboring animals to depredate their crops, denying them their traditional rights, etc. In this section, I will try and discuss the possibility of changing the people's opinion.

The future of wildlife conservation outside protected areas is doubtful. Suitable habitat for various species is being destroyed fast with the increasing human population. Even if there was a future to talk about, conservation efforts would be futile unless farm lands were fenced off. Otherwise, wildlife conservation is in direct conflict with agriculture. As long as the two forms of land use, i.e., agriculture and wildlife conservation, are in conflict, there is no hope of changing the people's attitude. As well, consideration would have to be given to allow some of the traditional methods of hunting, under controlled conditions, to give the people a feeling that the conservation efforts are for their benefit. This consideration would have to be given after the wild animal populations on farm lands increased sufficiently. Education of the public regarding principles of wildlife conservation is at the heart of the matter. Once the people are aware of the reasons that the laws are made, then they will obey them. All these would work if there was a bright future for wildlife conservation outside protected areas. But as I have already mentioned, the future of wildlife conservation outside protected areas is doubtful. The only hope for wildlife conservation is in the protected areas.

Protected areas that are a sanctuary for different wildlife species are game reserves, national parks and forest reserves. Most areas put under these forms of protection are classified as unsuitable for conventional agriculture. Forest reserves fall outside the jurisdiction of the Department of National Parks and Wildlife and will not be discussed further. Therefore, I will only concentrate on national parks and game reserves.

The bulk of the negative feelings towards national parks and game reserves arises from the lack of appreciation, by the majority of the people in Malawi, of the value of these areas. National parks and game reserves are areas where representative biotic communities of Malawi and their physical environments are preserved. Within the parks and reserves areas of aesthetic beauty and special interest are protected, populations of various species, e.g., rare, endangered and endemic. The parks and reserves also help in maintaining water supplies through catchment conservation. The areas also act as field laboratories for various scientific studies. Facilities are also provided to cater for visitors' enjoyment of the resources preserved in the parks and reserves. All these values are not appreciated by the average Malawian, hence the negative attitude. A great effort has to be made to try and educate the public regarding these values. The Department of National Parks and Wildlife, through its Education and Information Unit, has taken strides in this direction. The National Fauna Preservation Society of Malawi has also assisted in various ways. Efforts have been largely directed at school groups. Wildlife clubs have been set up in various schools and selected members of the clubs have been given a chance of visiting the parks and reserves where the conservation message is passed. Members of the department also go out to the schools to present talks. The Nature Sanctuary in the City of Lilongwe is an important component in passing on the conservation message. The resources and production subunit of the Education and Information Unit produces various pamphlets and leaflets for distribution or for sale at a very low price. With all these facilities, the public is getting educated about the importance of parks and reserves. Efforts are now being spread to the local communities surrounding the parks and reserves through organization of trips to the parks and reserves by community leaders. In 1981, community leaders in Chikwawa district visited Lengwe National Park. The officials, who included the District Chairman of the Malawi Congress Party and his officials, paramount Chief Lundu and other traditional leaders, and The Chairman of the District Council, among others, were greatly impressed with what they saw. Trips like the one mentioned would greatly increase the chances of passing the message to the public in immediate contact with the national parks and game reserve. Once awareness has been instilled, encroachments of various forms would cease.

Regarding the national parks and game reserves being sanctuaries of wild animals which depredate on people's crops, the Department of National Parks and Wildlife has recognized the problem and personnel in the Management Unit assist in combating the problem. Animals leaving the protected areas into farm lands are chased back into the areas, but if they cannot be moved back effectively, they are destroyed by shooting. The long-term solution to the problem is having the protected areas fenced off so that the majority of the animals do not get out into the farm land. Part of Lengwe National Park is fenced off but the fence has to be

regularly maintained to be effective. The fence at Lengwe is a regular wire fence and it is effective for most species, except warthogs, bushpigs, baboons and vervet monkeys. Warthogs and bushpigs dig under the fence. The fence is now being modified by placing the fence wire some 60 cm below the surface to take care of the warthogs and bushpigs. The baboons and vervet monkeys will jump or climb over the fence. This latter group will be a perpetual problem in areas around the parks and reserves even if the areas were fenced off. Use of solar powered electric fencing might solve this problem if used in combination with the regular fence wire. The area in the immediate vicinity of the fence would have to be cleared of tall objects to prevent the monkeys from jumping over. An electric fence has been used in Kasungu National Park against elephants with reasonable success (Bell 1984). The above are some of the popular methods used in minimizing damage to people's crops by wild animals. The mere fact that the department is doing something about the problem creates a favorable impression on the farming public.

Another view regarding game reserve and national parks is that resources therein are not being utilized. The people would like to see some consumptive use of the resources. If some consumptive use of the resources was allowed, clearly, the major opinion would change in favor of conservation. The culling operations in Lengwe National Park provide a good example of consumptive use of wildlife resources.

Culling operations have been carried out in Lengwe National Park since 1981. The species that have been culled are nyala and warthog. The main reasons for the culling are ecological. Nyala antelopes have increased in number to the extent that they have overshot the carrying capacity of the park. In 1980, a mini die off in which between 50-1 nyala died occurred (Bell 1981a). The cause of death was ascertained as starvation. In addition to the mini die off, deterioration of the habitat had been observed for quite sometime. Based on these facts, culling operations were suggested. In 1981, 400 nyala were shot and 19 were captured for a trial game ranch at Nchalo Sugar Estate (Kamvazina 1981). Following detailed population estimate in 1981 and 1982, it was recommended that 1,000 nyala antelopes should be cropped for three successive years (Bell 1981b, Bell and Banda 1983). Following these recommendations, a culling operation was carried out in 1983 during which 840 nyala were shot (see Chapter 19). In 1984, another cull was carried out and 957 nyala antelopes were shot. During the 1984 cull, warthogs were added to the list for culling. The addition of the warthogs on the culling list was recommended after observing that the animals grossly lost condition in the late dry season. In the 1983 dry season, between 50 and 100 warthogs died. The cause of death is believed to be starvation (Mphande 1984). One hundred and fifty-four warthogs were shot.

Although the main reasons for the culling operations are ecological, there are subobjectives associated with the cull which are revenue generation and public relations. The culling operations have given the Department of National Parks and Wildlife a golden chance to show to the people that wildlife conservation has tangible values such as sources of cheap protein. Meat from the cull was sold locally at a price of 60t per kg. in 1983. In 1984, a differential pricing was set which put the people in the immediate vicinity of the park at an advantage. People purchasing 5

kg. or less paid 60t per kg., while those purchasing more than 5 kg. paid K1.00 per kg. This pricing system ensured that more meat was available to a larger number of people and also put the local people at an advantage, i.e., they could afford to buy less than 5 kg., hence, pay less money since they could always come back after the supply was depleted, a thing that people from distant places could not do.

The culling operations have put a new perspective in the eyes of the people regarding wildlife conservation. The people have been made aware that wild animals can be money spinners and also a source of protein. With this awareness, the people's attitudes have changed in our favor. In an opinion survey conducted in 1983 during which people were asked what they felt about the pricing of nyala meat, among others, it was very clear that the people were happy with the culling operation and definitely with the price since it was lower than that of other meat offered on the market. Some people complained about the selling system, i.e., meat sales being conducted at Lengwe which is not served by any means of public transport, hence, they could not have a chance of buying meat.

With the culling operation example, it is clear that some consumptive use of the resources in national parks and game reserves would aid in changing the people's attitude. If the parks and reserves could earn a lot of revenue for the government, they would be looked at as a viable form of land use economically. Definitely, the tangible benefits would go a long way in changing our image.

Consumptive uses of resources in parks and reserves, however, have to be carefully planned to avoid overexploitation of the resources. The culling operations in Lengwe were based on ecological reasons, not economic or public relations reasons. Once the ecological goal has been fulfilled, the operation has to stop. If consumptive uses on a sustained yield basis are decided on, then continuous monitoring of the situation is needed to ensure overexploitation does not occur. The basic problem is that once emphasis is placed on revenue generation, there is a danger of losing sight of the conservation goal. Forms of consumptive use that can be considered are: fuel wood collection, honey gathering, timber extraction and trophy hunting (safari hunting), among others. Such consumptive uses have to be carefully planned to avoid overexploitation and also conflicts with nonconsumptive users.

National parks and game reserves are made accessible to visitors wishing to enjoy the resources in a nonconsumptive fashion, i.e., game viewing, sightseeing, etc. Individuals interested in these forms of use might be negatively affected by the consumptive users if the latter are not carefully planned. During the 1984 culling operation, a questionnaire was handed out to visitors entering Lengwe National Park with a view to assessing their feelings about the culling operation and also whether the culling operation affected their enjoyment of the park. Ninety questionnaires were handed out but only 20 were turned in. Out of the 20 that responded, 19 knew that culling was taking place, 19 knew the species that were being culled and how many of each specie were being culled. All the twenty knew the reasons for culling, but only 17 agreed with the reasons and three did not agree. On the question of whether the culling affected their enjoyment of the park, nine said yes while ten said no. Of the nine people that said

the culling operation affected their enjoyment of the park, only three had made visits to Lengwe previously. Of the ten that said the culling operation did not affect their enjoyment of the park, only three had visited the park previously. The important facts to note about this opinion survey are that the majority of the people that responded had not visited the park previously and that there was an almost half and half split between people whose enjoyment of the park was affected and those whose enjoyment was not affected. From these findings, it can be seen that even if consumptive uses are carefully planned, some negative effects will be felt by certain sectors of the public visiting the parks and reserves. The objective should be to keep the negative feelings at a minimum. Another fact to mention about consumptive uses of the resources is the ability to police these uses. If the uses are not strictly controlled, there is a danger of overexploitation.

5.   **CONCLUSION**:

Although wildlife conservation and management is designed to benefit the inhabitants of Malawi primarily, the majority of the inhabitants who are in the rural areas and engaged in subsistence farming have negative feelings towards wildlife conservation and management. These negative feelings are a result of lack of appreciation of the principles of wildlife conservation and management and also the conflict between man and wild animals on the farm lands, particularly those farm lands adjoining protected areas such as game reserves and national parks. These negative feelings have to be changed if the future of wildlife in the country is to be assured. The first step is to educate the people about the importance of wildlife conservation. The emphasis in this public education program has to be placed on populations in immediate contact with protected areas. Apart from impressing upon the people the conventional values of protected areas, i.e., preservation of representative biotic communities and their physical environment, preservation of areas of aesthetic beauty and special interest, their value as field laboratories, and their assistance in ensuring water supplies through catchment conservation, it is important that some consumptive uses of the resources which are compatible with the conservation goals are considered. These latter values derived from consumptive use of the resources would be more easily appreciated by the public. Consumptive uses would have to be carefully planned and strictly controlled to avoid overexploitation. Regarding the man and wild animal conflict, the long-term solution is fencing off the protected areas which are the major sanctuary for wild animals. Animal populations outside protected areas are negligible. In the meantime, the current control measures, e.g., shooting of offending animals, have to be continued.

If the above are achieved, the majority opinion will change in favor of wildlife conservation and management and the future of wildlife in Malawi will be assured.

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SECTION 5

THE CONTROL OF CONSERVATION ACTIVITY

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CHAPTER 30

THE CONTROL OF CONSERVATION ACTIVITIES

BY

J.E. CLARKE & R.H.V. BELL

1.   INTRODUCTION:

A conservation agency's activities are controlled by an interlocking set of components, which are described below. Ideally, the control system should be established as a self-consistent whole, but this is rarely the case for historical and organizational reasons. For example: conservation policy and legislation have often developed piecemeal; protected areas and plans have been adopted on an *ad hoc* basis; and funding is often controlled by bodies outside the conservation agency.

We believe that the effectiveness, efficiency and competitiveness of conservation agencies would increase if the relationships between the control components were recognized as the basis of a coherent organizational system. Together they form a control system with objectives; plans for pursuing objectives; the means of doing so; and channels for reporting progress towards objectives and evaluating the effectiveness of different activities. In short, they represent the components of a negative feedback control system, which embodies the concept of adaptive management.

We do not recommend a monolithic organization in which all activities are predetermined, but rather a system which is both coherent and responsive to change. When a policy change is made, it should be reflected where appropriate in legislation, planning and funding; and funding and planning should be related to extant policy and legislation. Where feedback through reports indicates that a fresh approach is necessary, this should be followed by appropriate changes in planning, funding, legislation and policy.

2.   COMPONENTS OF THE CONTROL SYSTEM:

The components of the control system are described briefly below. Different conservation agencies may employ slightly different terminologies, but most will have their equivalents to the terms which we use.

a.   Government Policy:

This is a statement of recognition and intent by the government. It expresses the official perception of wildlife resources and describes how the state intends to manage them so as to optimize their benefits for man.

b.   Legislation:

This is the body of statutory law which controls the management and use of wildlife resources. It represents the legal expression of government policy. Statutory law is usually two-tiered, comprising primary legislation, produced by the legislature and subsidiary legislation, which is usually promulgated by a government minister.

c.   Master Plan:

This document sets out in detail the long-term objectives of the conservation agency and the means of pursuing them. It is based upon policy and legislation, but may also recommend modifications to them. It

may equate with subsidiary legislation in that it mandates action on the part of the agency.

The master plan's time horizon must be sufficient to sustain long-term continuity in its management programs. It may look 20 or 25 years ahead or even longer in some cases. Where, however, a master plan prescribes specific development its time horizon may be shortened, but even here it is unlikely to be less than five years.

The master plan addresses all aspects of the agency's activities, and it outlines the needs for action and expenditure over specified periods in the future. As such, it provides the basis for estimating expenditure and funding requirements for those periods and for planning manpower development. The latter includes establishments, conditions of service, recruitment and training.

Although the master plan is subject to continuous review, amendments are subject to approval by the highest policy making level in the agency and possibly to higher authority.

d. Management Plans:

These may be integral parts of the master plan or they may exist as separate documents. If they are separate, they nevertheless conform with the master plan. Management plans normally prescribe management strategies for specific areas, species or activities of the agency. The latter include subjects such as pest control, conservation education, public relations, etc.

e. Development Plans:

Development plans describe the programs which are needed to fulfill the development requirements prescribed in the master plan and management plans. They do so in terms of the needs for developing infrastructure and manpower, and they specify the required financial inputs.

f. Estimates:

These are submissions for funding requirements based upon the prescriptions of the master plan, management plans and development plans. Estimates may be for capital or recurrent programs. Capital estimates normally refer to development plans. Recurrent estimates usually relate to the agency's annual budget.

g. Project Submissions:

These are descriptions of proposed projects. Projects normally incur capital funding but submissions may include provision for supporting recurrent expenditure over a specified period. The latter may be requested to support or maintain newly developed infrastructure for one or two years, but eventually this support will be funded through the agency's annual recurrent budget.

h. Budgets:

These are the statements of fund allocation, initially from the government to the agency as a whole, and secondarily from the agency directorate to its various branches. In theory, budgets should relate to the overall control structure; but this is usually the stage at which actual progress begins to deviate from policy and plans.

i. Aid:

Aid comprises funds donated or loaned by external agencies usually in response to project submissions. Aid may come from government or nongovernment agencies, and from within or outside the home country.

j. Work Programs:

These prescribe the actions by which each section of the agency is to carry out the appropriate components of the master plan or management plan, within the limits imposed by available funding and other constraints. The time scale is usually annual.

k. Reports:

Reports may be of an individual nature referring to specific projects or programs; or they may be regular--e.g., monthly, quarterly or annual. They are prepared at all levels within the agency for submission to the supervisory levels above. Reports are also prepared by the agency directorate for submission to the parent ministry. Agency annual reports are often published and are thus available to the public.

Within the agency, reports provide the feedback channel by which progress is assessed in relation to objectives set out in master plans, management plans and work programs. They cover all facets of agency activity. Correctly designed activities, leading to the compilation of reports that allow activity evaluation, are an essential feature of adaptive management. This is elaborated in the chapters of this volume that consider law enforcement, wildlife control and public relations.

3. CONCLUSIONS:

A set of components, such as that described above, forms the basis of the control system for a conservation agency. It is the system by which objectives are set, actions are planned and executed, procedures are monitored and evaluated, and by which necessary modifications are introduced. Each activity or act of management should be designed to test the theory on which it is based. It must be planned, recorded and reported in such a way that an assessment can be made of whether it is actually achieving the objectives specified in policy, legislation, master plan, management plan and work program. This characteristic, known as adaptive management, should be built into the structure of the agency at the level of the design of each type of control component.

CHAPTER 31

WILDLIFE MANAGEMENT POLICY

BY

J.E. CLARKE & R.H.V. BELL

1. POLICY MAKING:

Government policy is, as with any other activity, the most important factor in determining government involvement with wildlife resources. It is remarkable, therefore, that many African countries have no formal statement of policy on wildlife. Of the ten countries represented at the Lifupa workshop, only one (Malawi) had adopted such a statement. The implications of this are considerable. They suggest that wildlife management in the majority of African countries has developed, and is conducted, on a purely *ad hoc* basis.

The answer to the question "who makes policy?" will vary according to circumstances in different states. Several government agencies may be involved; in particular, the ministries, the legislature, the judiciary, the armed forces and the political parties. Pressure groups outside the government may play a role. However, the most important input is likely to come from the technical agency itself. This raises a problem which is discussed below.

Although policy statements generally emanate from the head of state, from the collective voice of central government, or from a ministry, these levels are rarely in a position to contribute anything but the broadest policy outlines. In a specialized sphere such as wildlife management, these levels lack professional expertise, and the formulation of policy detail is delegated to the technical agency. Policy is, therefore, generated at middle management levels but is formally adopted at higher levels; and this, we believe, occurs without a thorough appreciation by the higher government levels of the implications, consequences and requirements of the policy. This can lead to contradictory action at a later stage. At worst, the technical agency may exploit this weakness by attempting to foist ideals which it considers desirable, but which are, nonetheless, impracticable into formal government policy. Equally, circumstances may change so that it is neither possible nor politic for the *de facto* policy to correspond with formal policy.

This problem is fundamental to organizational control: policies and plans are only relevant if they are followed. They are no stronger than the people who use them. It is important, therefore, that all government levels should be thoroughly familiar with government policy on specialized topics. In pursuance of this, we believe that policy should be widely publicized. Some ways in which this may be done are suggested at the end of this chapter. The more that wildlife policy and practice are publicized and understood, the less are the chances of the two getting seriously out of phase. If publicity leads to disagreement, then the machinery for changing policy can be set in motion. A mechanism for ensuring the production, revision and use of policy at various government levels is proposed in Chapter 35, which considers master plans.

2. POLICY CONTENT:

Wildlife policy provides a framework for answering four questions:

    (i)   Which wildlife does the state want?

    (ii)   Where does it want it?

    (iii)   How much does it want?

    (iv)   How does it want to manage it?

To answer these questions requires that the policy establishes guidelines for defining categories of wildlife and land related to wildlife status.

Wildlife policy should be based on a definition of "wildlife" that encompasses all plants and animals living in the wild. Within this broad definition, policy can then recognize wildlife of different value and management significance: some wildlife are valuable, some are neutral or insignificant and some are harmful or undesirable. Categories of wildlife are subsequently defined by legislation. Similarly, policy and legislation should also provide the framework for appropriate management of each wildlife category in each land use category.

For each category of wildlife and land, there are six main management options:

    (i)   **Preservation** at ecological carrying capacity for nonconsumptive uses.

    (ii)   **Conservation** below ecological carrying capacity for sustained consumptive use.

    (iii)   **Capital reduction** below ecological carrying capacity for unsustained consumptive use.

    (iv)   **Control** to levels compatible with other forms of land use, which are of higher priority.

    (v)   **Captive domestic or cultivated management** for consumptive or nonconsumptive uses.

    (vi)   **No management** where the population is either insignificant or incapable of being managed.

A key question in wildlife policy is that of ownership and control, and that is--responsibility. For any given combination of wildlife and land category, who decides which management option is to be adopted? Is it to be the central government (and, if so, which agency), the local government or the landowner? Guidelines for establishing this point should be given in the policy. The policy should also clearly lay down which agency is responsible for controlling mineral resources in each land category.

Within the broad framework of wildlife category, land category, management strategy and responsibility, there is a limitless number of possible combinations. The Malawian government's policy on national parks and wildlife is quoted below as an example. This policy statement is included in the Principal Master Plan for National Parks and Wildlife Management (Clarke 1983), and it has been formally adopted by the Ministry of Forestry and Natural Resources.

3. **THE MALAWI GOVERNMENT PARKS AND WILDLIFE POLICY:**

   a. The Government of Malawi's parks and wildlife policy is an integral component of its overall land use policy.

   b. The government recognizes that wildlife is a complex of renewable natural resources that has positive and negative values in relation to human needs. The government's intention is to manage these resources in a professional and scientific manner for the benefit of man, in particular, the people of Malawi.

   c. In the context of this policy, wildlife means all species of wild, indigenous plants and animals. It includes undesirable as well as desirable species, and those that may be considered insignificant. The policy acknowledges a fundamental ecological principle that all components of ecosystems are interrelated so that species do not live in isolation.

   d. The Government of Malawi recognizes that the actual and potential benefits of wildlife to man are many. Wildlife can provide aesthetic benefits including scientific, cultural and recreational values. It can make contributions to the welfare and productivity of other forms of land use such as agriculture, ranching, and forestry.

   Wildlife can enhance environmental quality and act as an indicator of its quality. It can act as a reservoir of genetic diversity, and it can provide utilitarian benefits such as food, hides, timber and revenue from utilization. Some of these benefits are apparent only in the very long term, but they are nonetheless important. The government, therefore, declares its intent to assess its wildlife management responsibilities in the light of the broadest social and ecological requirements, rather than in the light of short-term financial considerations.

   e. The Government of Malawi recognizes three broad classes of wildlife management: conservation, utilization and control. These are not necessarily mutually exclusive. More than one type of management can be applied to any species or situation.

      (i) The purpose of *conservation* is to ensure the survival of wildlife that is beneficial to man. One aim of *conservation* is the setting aside of protected areas in which to preserve selected examples of Malawi's wildlife communities, especially those that contain rare, endangered or endemic species, or areas that have unique features and are, therefore,

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of international importance. The second aim of *conservation* is to ensure survival in optimum numbers of species managed for *utilization*.

(ii)   The purpose of *utilization* is to derive utilitarian benefits from wildlife. The government recognizes this as a legitimate form of land use in situations where it does not conflict with other forms of land use, such as preservation on the one hand and agriculture on the other.

(iii) The purpose of *control* is to reduce the detrimental effects of wildlife on human life and property.

f.   The Government of Malawi intends to manage its protected areas, the national parks and game reserves, in accordance with the following guidelines:

(i)   The reasons for having and managing national parks and game reserves are:

(1) to preserve selected examples of Malawi's biotic communities and their physical environments;

(2) to protect areas of aesthetic beauty and of special interest;

(3) to preserve populations of rare, endangered and endemic species of wild plants and animals; and

(4) to assist in maintaining water supplies through catchment conservation, and thus to benefit agriculture in adjoining land, and to promote fish conservation and fisheries management downstream.

(ii)   Further reasons for having and managing national parks and game reserves are:

(1) without prejudice to (i), and within any limitations imposed by it, to provide facilities for studies of the phenomena therein for the advancement of scientific understanding; and

(2) without prejudice to (i) and (ii) (1), and within any limitations imposed by them, to provide facilities for public use and enjoyment of the resources therein.

g.   The Government of Malawi recognizes five important principles as underlying its parks and wildlife management program:

(i)   **Management by a Professional Agency:** The government's agent in wildlife management is the Department of National Parks and Wildlife. The government is committed to ensuring that all officers appointed to this department have adequate, relevant, professional training and experience.

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(ii) **Adequate Funding for Parks and Wildlife Management:** The government recognizes that revenue generated by the department may not cover the expenditure required to meet the government's objectives. The government is committed to ensuring adequate funding for the department so that it may achieve the objectives in a professional manner.

(iii) **Research, Monitoring and Adaptive Management:** The government recognizes that wildlife is an exceptionally complex activity in which many factors are unknown or not fully understood. The government is, therefore, committed to an adaptive management strategy in which research and monitoring are incorporated as integral components and each act of management is designed as a trial, the performance of which can be assessed and improved upon, if necessary.

(iv) **Public Education and Participation:** Public understanding and appreciation of wildlife and the reasons for managing it can lead to enhanced support for the government's programs. This positive step is to be actively encouraged. The government intends to foster public understanding and participation throug the department and through the schools' curricula. The government also welcomes private, voluntary organizations that are concerned with the conservation and management of wildlife.

(v) **International Cooperation:** The government recognizes that wildlife management cannot be carried out in isolation in view of the fact that ecological, cultural and commercial processes are continuous irrespective of international borders. The government is, therefore, committed to cooperation with other governments and international agencies in managing wildlife communities and controlling illegal trade in wildlife products.

h. The government appreciates that, in practical terms, a large proportion of wildlife is either insignificant or incapable of being managed by the state. The government sees the need, therefore, to recognize two categories of wildlife: those whose management is controlled by the state, and those that are not managed by the state. The species or individuals, or the situations, that should be subject to state management would be defined by appropriate legislation. Wildlife not subject to state management could be conserved, utilized or controlled by the public as it saw fit. Categorization would be under continuous review; and to assist its monitoring of unmanaged wildlife, the government would require any major development project to be preceded by a wildlife impact assessment.

4.   PUBLICIZING AND DISSEMINATING GOVERNMENT POLICY:

A state's wildlife policy ought to be given wide publicity within the country, both in government and nongovernment circles.   One method is to include a statement of policy and objectives as a preamble in the laws as has been done in recent U.S. legislation.   Such a statement gives a guide to those who use the written laws, but it does not provide for wide circulation.   To achieve a broader distribution, a specially prepared explanatory booklet or brochure may be published.   A good example of this type was produced in Northern Rhodesia (now Zambia) (Anon 1961).   It described, in everyday language, the aims of the government and how it intended to achieve them.

The state may also arrange for its policy to be explained in the newspapers by paid advertisements or feature articles.   Radio and television also provide opportunities for publicity, especially in countries where newspaper distribution is limited and literacy rates are low.

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CHAPTER 32

WILDLIFE LEGISLATION

BY

J.E. CLARKE & R.H.V. BELL

1. INTRODUCTION:

Our purpose in this section is to discuss key points for attention when wildlife legislation is being written or revised. There is insufficient space to review the whole range of African wildlife legislation, and such specifics as are quoted here are given as examples rather than recommendations. We are, of course, aware that the final decision on legislation is the exclusive prerogative of the legislative branch of each country.

This chapter is based on ideas developed while compiling a draft legislation for the state of Jordan (Clarke 1979), a model wildlife legislation for developing countries (Clarke 1981) and a proposed draft National Parks and Wildlife Act for Malawi (Clarke 1983). The senior author is currently engaged on a similar exercise in the Sultanate of Oman. Since 1983, the two authors have engaged in extensive dialogue on the subject and their ideas are still actively evolving.

Simplicity of language is a desirable feature of wildlife legislation. It should be comprehensible and provide a source of reference, not only for lawyers and courts but also for members of the managing agency who implement the laws. As Conrad (1947) put it, "Laws should be written with more emphasis on making readers understand what the law commands, and with less emphasis on controlling the judges by rigid grammatical constructions."

2. WILDLIFE IS BASED ON POLICY:

Legislation must be based on policy. It holds an analogous status to a computer program which transforms a conceptual model (the policy) into a mechanically rigorous statement in which any set of conditions produces an internally consistent and unambiguous outcome. Such programs are complex and the human computer is not as rigorous as the mechanical type so that much debugging and interpretation is required. This is what the judiciary is for. However, the ideal is to produce simple, unambiguous legislation that accurately reflects policy and is capable of being put into practice.

The designer of new wildlife legislation may find that no clear policy exists, or that existing policy appears inadequate or contradictory. In practice, therefore, the preparation of new laws should involve at least a critical evaluation of extant policy and may involve drafting new policy.

3. SCOPE OF THE LEGISLATION:

A key feature of policy is the scope of legislation. Decisions must be made as to which natural resources and which influences that affect these resources, are to be subject to the law. For example, a large range of organisms that are included in the definition of wildlife (see below) are often covered by other legislation, such as fisheries and forestry acts. Other closely related resources such as water, soils and geological resources are also often covered by individual legislation. Examples of influences that affect natural resources are pollution, development zoning and human population control (cf., Bean 1977).

The exact range of jurisdiction of these sets of legislation is, as we have said, a matter of policy. The details are not necessarily critical if the different acts are mutually compatible and if they reflect policy and civil service structure. In Malawi, crocodile management is controlled by the Department of Fisheries, a rather uneasy placing reflecting an obsolete policy. In the legislation outline that follows, it is possible to treat all wildlife with exact equivalence, so that wildlife, fisheries and forestry legislation could be completely compatible. An important point that must be clarified both in policy and legislation is which agency is responsible for decisions concerning mineral and water developments in each land category. In Zambia, for example, the act covering wildlife does not exclude mining from national parks; the minister responsible for national parks is empowered to define limitations upon the way that mining is conducted, although these may not be so restrictive as to prevent mining taking place.

4. PRIMARY AND SUBSIDIARY LEGISLATION:

Most countries have a two-tier system of lawmaking, in which primary legislation is created by the legislature and head of state, while subsidiary legislation is promulgated, usually at the ministerial level in the form of regulations. The dividing line between primary and subsidiary legislation varies widely between countries and is a matter of policy, influenced by tradition and legal history. If legislation is equivalent to a computer program, primary legislation is equivalent to instructions incorporated in the program, while subsidiary legislation is equivalent to instructions read in as data.

In some countries (for example, the U.S.A.), primary legislation may sometimes comprise only declarations of policy and intent. The statutory regulations, which define lawful and unlawful behavior, are promulgated at ministry or secretary level. The U.S. National Forests Act is an example of this type. Most eastern African countries, however, with their British legal background, have primary legislation comprising specific rulings on matters of detail, for example, no hunting without a license, or no off-road driving in national parks. The subsidiary legislation, by contrast, contains regulations which are liable to alteration from time-to-time. For example, in some countries, hunting rules are specified in subsidiary legislation rather than in the main act, with the intention that they should be subject to regular review, which is more easily accomplished if they are published as regulations by a minister rather than in an act over the signature of the head of state.

This brings out the essential difference between primary and subsidiary legislation, that is the range of consultation that has to take place, and, hence, the ease and speed with which it can be modified. More important legislation has to go through the full legislative process and, hence, tends to be much slower and must be acceptable to the legislature (i.e., parliament) as a whole. Subsidiary legislation can be adopted within one ministry and is, therefore, faster and easier to modify, and need not be as well tuned to the feeling of the legislature, that is, it can represent relatively unilateral decisions by part of the executive branch. This is an important point and it raises the question of responsibility and accountability that will be discussed below.

In eastern Africa, topics that are sometimes subject to subsidiary legislation include allocation of wildlife to special classes (i.e., vermin), hunting license quotas, fees and other details, boundaries of the lower levels of protected area (i.e., game reserves and controlled hunting areas but not usually national parks), hunting and fishing rules (i.e., weapon types and net mesh sizes), park entry fees, etc. In the system proposed here, the most important topics subject to subsidiary legislation are the allocation of wildlife species to the various categories established by primary legislation, and the allocation of land to the various wildlife use zones.

5. RESPONSIBILITY AND ACCOUNTABILITY:

The history of constitutional law has been the history of the evolution of the balance of powers. Progressively, major decisions have been required to be subject to scrutiny and approval by a range of individuals and bodies.

Wildlife legislation has tended to be old-fashioned in this respect, concentrating very considerable powers in the hands of the minister responsible for the conservation agency. This system has all the advantages and disadvantages of centralized government. If it works well, it works very well; if it works badly, it works very badly. It is heavily dependent on the competence and value system of a few individuals.

For this reason, wildlife legislation in some countries attempts to establish a balance of responsibilities between two or more bodies. One way of doing this is to establish a board which the minister is obliged to consult on certain types of decisions and to which the agency head is accountable. The composition of the board, and the legal relationships established between minister, board and agency head vary considerably between countries. In the proposed Malawi legislation, the board is called a Scientific Wildlife Board. The minister is obliged to consult the board over major policy issues, such as alteration of a protected area boundary (i.e., modifying the allocation of a piece of land between wildlife utilization zones), modifying the allocation of a species between wildlife categories, modifying penalties and adopting or authorizing a major management decision such as to introduce an exotic species or to initiate a culling program. However, the minister is not obliged to accept the board's advice. The object of the board is to ensure that major decisions are made under open scrutiny, in the light of adequate technical information and a spectrum of value systems.

The composition of the board is obviously crucial, and poses an interesting minor exercise in constitutional law. The underlying objective of all constitution writers is to perpetuate their own value systems. Wildlife agencies, often repositories of strong and unpopular values are no exception, and the splitting of conservation agencies into Game Department (government departments) and National Parks Boards (nongovernment agencies) in East Africa after World War II was an example of this. The object was to remove the prime conservation areas from government departments before independence and place them under the responsibility of boards of trustees selected for sharing the value system of the conservation-minded expatriates who engineered their establishment.

However, as at Lancaster House, the one solid lesson learned is that one cannot perpetuate a value system by constitutional forms if it is not in tune with that of the people who have to live with it. The key question then, in constituting the Scientific Wildlife Board, is where does the conservation ethic reside? The answer will vary, of course, depending on the point of view of the asker and on the social environment. In the U.S.A. or Europe, one might expect it to be permeated widely through the professions and technical and academic bodies, and a reliable board could be constituted from these sources. In an African country, however, there is at present likely to be only one significant source of individuals with a scientific and professional interest in conservation, and that is the conservation agency itself, many of the senior staff of which are likely to have received higher education in conservation-related subjects either overseas or in such institutions as Mweka (Tanzania) and Garoua (Cameroon). The importance of such institutions as the repositories of the conservation ethic can hardly be overestimated.

In the Malawi draft act (Clarke 1983), we proposed a Scientific Wildlife Board dominated by members from outside the government (i.e., the National University, the Wildlife Society, etc.). However, in the light of the above considerations, we have revised this view and now suggest a Scientific Wildlife Board consisting of the minister or his representative, the agency head, and all the staff members of the agency of senior professional officer rank, as well as representatives of other agencies (i.e., Antiquities, Wildlife Society, National University, etc.). This seems to be the best way to ensure informed, professional scrutiny of major decisions. We propose that this board must meet at regular intervals and must be consulted on specified topics. However, the minister is not obliged to accept its advice.

We do not claim that this is necessarily the only, or the best solution. However, we do urge that this aspect of the legislation be given very careful consideration, particularly on the responsibilities allocated to the various bodies, the legal obligations between them, and the constitution of the board.

6. MASTER PLANS:

Following from the recommendation that major policy decisions should be subject to informed professional scrutiny by a Scientific Wildlife Board, is the need for a structured framework for such decisions, so that they are not viewed in isolation. This is the role of the master plan. We recommend that the overall agency master plan including its component management plans and development plans be required by primary legislation to be subject to regular review by the board. In the event of a new area coming under the responsibility of the agency, we recommend that the agency head be obliged to present to the board a master plan for the area, including a statement of the purposes of the protected area and a statement of management measures to be taken within the area so as to achieve the stated purposes. The contents of the master plan and its compilation and review are summarized in the next chapter.

7. CATEGORIES OF LAND:

Most countries have a number of categories of land that differ in terms of permissible utilization of natural resources. These include national parks, national reserves, game reserves, forest reserves, game management areas, safari areas, controlled hunting areas and open areas to name a few. Each category permits a particular range of uses of natural resources. The most protected categories, corresponding to the "national parks and equivalent reserves" of IUCN (Anon 1980) in theory permit minimal consumptive uses; open areas permit most forms of use including agriculture, except, usually, for hunting of some large mammals without license. Between these extremes is a wide range of intermediate use categories.

On examination of these categories, we have concluded that the fundamental division is between those that allow settlement (other than by conservation agency staff), agriculture and livestock husbandry (here called open areas), and those that do not (here called protected areas). We feel that, within the protected area category, it is impossible to discern a logical, consistent or practical division between different levels of use sufficient to justify a distinction by primary legislation.

We maintain that protected areas in which the absence of consumptive utilization is rigorously applied are so rare as not to constitute an important category of land. The same point has been made by Anderson (1983) after analysis of the U.N. list of national parks and its criteria for inclusion of areas (Harroy 1971); he notes that at least 29 listed national parks allow hunting and very many allow fishing. If we add to these uses "the modification of the physical or biological environment in the interests of the use or management of the area," then it is doubtful if any protected area can be said to be completely unmodified by man. This, we argue, removes the sense of the distinction between consumptive and nonconsumptive uses.

We argue, therefore, that the only way to distinguish rigorously between levels of use, certainly within each of the two major categories, is by specifying the objectives and intended management procedures for each area (protected or open) in detail, that is, by compiling a master plan for the area. This is why we place such heavy emphasis on the master plan; why we recommend that a master plan be produced for each area within a year of the agency assuming responsibility for it; why we feel that the master plan should be formally accepted by the minister after consultation with the Scientific Wildlife Board; and, why we feel that any modification of the master plan should be adopted in the same way. The master plan defines the objectives and permissible management procedures and uses for each area. Once a master plan is formally adopted by a minister, its powers should be equal to those of subsidiary legislation. This equality of power should be laid down in the primary legislation.

This point of view is implicit in the proposed act for Malawi (Clarke 1983) in which only one category of protected area (national parks) is recognized, in which a range of consumptive uses including hunting and culling is permitted if specified in the master plan. However, it is a somewhat radical point of view which is by no means universally accepted.

Other countries have tended to try to specify grades of use in primary legislation, giving different use categories distinct names as listed earlier. However, in most legislation, wide latitude is given to the minister or agency head to permit various uses under the primary legislation, leading to very confused and inconsistent situations.

It is, of course, perfectly logical to subdivide the two primary land categories (protected and open) into subcategories with distinct names (i.e., national parks and game reserves or safari areas and game management areas) either by primary or subsidiary legislation, by means of defined sets of permissible uses for each. However, category definitions would have to be very precise, and each area would still need a master plan consistent with its use category. The only major difference would be less flexibility if use levels were defined by primary legislation. Some might see this as an advantage in high conservation priority areas, although in our system rare or endangered species are further protected by a second dimension of legislation concerned with categories of wildlife (see below).

Within the open area category, we feel that there is a good case for subdivision into perhaps four subcategories, as follows (although all but the first could be contained within the master plan system recommended above):

a. Conservation Areas:

The concept discussed here concerns multiple land use units in which agriculture, livestock, settlement, fishing, forestry, etc., are permitted as well as consumptive and nonconsumptive wildlife uses. However, human activities, particularly settlement, agriculture and livestock densities are controlled while wildlife is given equal weight or even priority. This concept has often been suggested, particularly in the areas adjacent to major conservation areas. In 1978, an IUCN consultant was requested to draft a proposed Conservation Area Act of this type for Malawi, but it has not been enacted. The essential feature of any such legislation is the establishment of an interdepartmental body (probably, in fact, inter-ministerial) to balance the interests of the various forms of land use. Responsibility for such land areas would necessarily be allocated to this body by primary legislation and the detailed land use plan (master plan) would embody the subsidiary legislation. We are not aware of any major examples of this type in Africa. It is an interesting and stimulating concept, but we foresee considerable difficulties in constituting it in such a way as to perpetuate a balance between conservation interests and economic interests that will be acceptable to all parties.

b. Developed Areas:

These areas are those areas of developed, settlement, agriculture and livestock husbandry. Here, the conservation agency is obliged to remove or allow removal of all large vertebrates liable to damage life and property (i.e., usually the nonrefuge-requiring species hippo, crocodile, leopard, baboon, monkey, etc., but occasionally "pocketed" members of refuge-requiring species, elephant, buffalo, etc., see Chapter 26). How this is done (i.e., by killing or translocation) depends on the category of

wildlife. Again, we are not aware of any case of formal definition of such a land category in Africa, but such a category is widely assumed tacitly.

c.   Private Land (Leasehold or Freehold):

Here the question of the ownership of wildlife is raised. This will be discussed below, but a good case can be made for transferring ownership (by subsidiary legislation) of most of all categories of wildlife to the landowner. The land category could include land adjudicated as group ranches (as in Kenya) or land incorporated in communal projects such as CAMPFIRE (in Zimbabwe) (Chapter 20).

d.   Other Open land:

This is all open land not included in the above categories.

8.   CATEGORIES OF WILDLIFE:

The allocation of wildlife to a series of formal categories is central to our approach to wildlife legislation. A similar division has been carried out in many other wildlife acts both in Africa and elsewhere, for example, in the identification of "royal game," "vermin," "protected trees," etc. Our objective is to try to carry this approach to its logical conclusion by including all species of animals and plants in the category system, and regulating all types of interactions of people (including international legislation) with wildlife in relation to the categories of wildlife and the categories of land. Wildlife-human interactions are, thus, regulated according to a three-dimensional matrix, of which the dimensions are:

   a.   Category of wildlife

   b.   Category of land

   c.   Category of interaction

The details of the wildlife category system are open to discussion and adaptation to suit particular circumstances. The system offered here differs slightly from that proposed in the draft act for Malawi (Clarke 1983), having evolved from it. The system is best summarized in the following diagram:

FIGURE 1

THE CATEGORIES OF WILDLIFE AND OTHER ORGANISMS
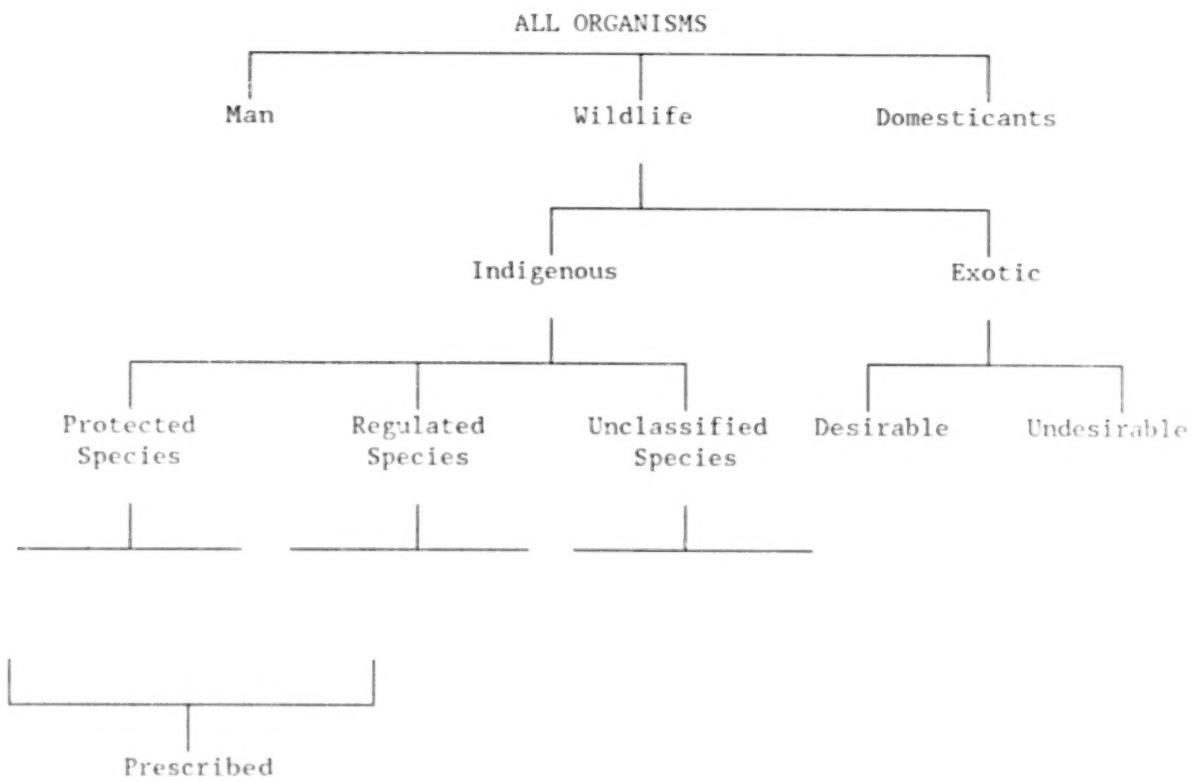
In this system, all members of a species and all parts and specimens derived from them, belong to the same category (with the exception of domesticants, and exotics, see below). Thus, if elephant is a regulated species, all elephants, whether in protected or open areas, and all ivory, whether derived locally or from another country, are covered by the regulated species legislation appropriate to the area category and category of interaction.

In this system, the definitions of the categories and the constant features of the legislation related to each are defined in primary legislation, while the features subject to regular review (i.e., the species placed in it, the details and costs of hunting licenses, the limits to penalties for offenses, etc.), are promulgated by the minister as subsidiary legislation after consultation with the Scientific Wildlife Board and take into consideration international commitments (i.e., the Convention of the International Trade in Endangered Species, C.I.T.E.S.)

Certain members of these categories will be covered by other legislation, i.e., fisheries or forestry laws. For these cases, a mechanism must be established for resolving conflicts, for example, consultation between responsible ministers, which if irreconcilable should be presented to parliament for decision. However, it should be noted that the category system suggested here is equally well-suited to fisheries and forestry legislation. All that is required is a definition (preferably by primary legislation) of which groups of species are the responsibility of which agency. This may differ between categories of land; for example, fish might be the responsibility of the fisheries department except in protected areas, where they would be the responsibility of the conservation agency. Equally, the forestry department might be responsible for wild animals in forest reserves. These are policy matters which have to be spelled out in legislation.

In the wildlife category system proposed here. the contents of each category are specified by subsidiary legislation and are under continuous review. A species may at any time be moved between categories by the minister after consulting the board. However, guidelines are given for the definition of each category.

The category of *man* of course presents no problems of definition. The category of *domesticants* covers both domestic animals and cultivated plants. It includes all those members of listed species (cattle, dogs, maize, tobacco, etc.) that are under human control. Members of these species that are not under control (feral dogs, Himalayan raspberry, etc.) are classed as exotics or indigenous wildlife as appropriate. Members of wildlife species kept under control (i.e., ranches, zoos, pets, etc.) are not classified as domesticants and come under wildlife legislation. The dividing line between "wildlife" and "domestic" is not clear cut and must be drawn according to the particular objectives of the law as perceived by the legal designer.

The category of *wildlife* includes all organisms apart from *man* and *domesticants*. It is subdivided into *indigenous* species and *exotic* species. *Exotic* species are those which do not normally occur in the country and are listed by name in subsidiary legislation as required. *Exotic* species are

further subdivided into *desirable* and *undesirable* exotics. The former category contains species whose spontaneous arrival or importation is allowed or encouraged, as in cases of extension of range of a species from a neighboring country. Examples might be the arrival or import of giraffe or puku to Malawi, of lion in Liberia or of eland in Lesotho. *Undesirable* exotics comprise a larger category whose arrival or import is resisted and whose populations are extirpated if possible. Examples might be kangaroos in Zambia or red deer in Kenya. Certain members of *undesirable* exotic species may be classified as *desirable* on condition that they are retained under control in special facilities, i.e., zoos, laboratories, etc. The decision as to which species are *desirable* or *undesirable* is an aesthetic decision (Bell 1983).

Indigenous wildlife includes all other species apart from exotics. These are subdivided into three categories, *protected*, *regulated* and *unclassified* species.

The *protected* species category is designed to cover those species of highest conservation priority, i.e., rare and endangered species, where every attempt is made to limit off-take by allowing killing by special license only (given by the minister after consultation with the board), by enforcing the most restrictive trade regulations and by awarding heavy penalties (set by subsidiary legislation). The species included in this category are promulgated as subsidiary legislation by the minister after consultation with the board.

The *regulated* species category is designed to cover those species which are not endangered but where control of off-take is considered desirable either because they might become endangered or because their use may constitute an important source of revenue through license fees, etc. Off-take is permitted under the conditions of a general license. Quotas are controlled by master plans and trade restrictions depend on whether the species is also a *prescribed* species (see below). Penalties for offenses are lower and set by subsidiary legislation. The species included in this category are promulgated as subsidiary legislation by the minister after consultation with the board.

The unclassified species category includes all species not listed under the former two categories. Government makes no attempt to manage or control the use of these species except in protected areas, unless requested to do so by the public (i.e., wildlife control). There are no restrictions on use, ownership or trade except in protected areas.

The *prescribed* species category is concerned strictly with movement and trade of live animals and products. It includes all *protected* species and certain specified *regulated* species. It includes those species for which uncontrolled trade is considered a possible threat to the species. Export is conditional on obtaining an export permit, to obtain which a certificate of ownership must be produced.

The definition of categories of wildlife under primary legislation is designed so that national compliance with the Convention of the International Trade in Endangered Species (C.I.T.E.S.) is facilitated. This is, strictly speaking, mandatory for any state which has acceded to the convention.

9.   CATEGORIES OF USE AND INTERACTION WITH WILDLIFE:

As noted earlier, the details of the legislation are contained in a three-dimensional matrix, taking into account category of wildlife, category of land and category of use or interaction.

' For each type of wildlife and each category of land, at least the following interactions have to be considered (of course, certain regulations are independent of land category):

a.   The policy or objective for the situation in question (i.e., type of wildlife and area);

b.   The type of license required for off-take (i.e., special, general, no license, etc.);

c.   The price, methods, rules and quotas specified by the license;

d.   The regulations concerning other direct influences (i.e., molesting, cruelty, burning, etc.);

e.   The action to be taken if an animal is encountered wounded;

f.   The action to be taken if an animal is wounded by a hunter;

g.   The action to be taken if an animal (or plant) represents a danger to life;

h.   The action to be taken if an animal (or plant) represents a danger to property;

i.   Ownership of live organisms;

j.   Ownership of dead organisms or their parts;

k.   Certification of ownership;

l.   Requirements for legal export;

m.   Correspondence with CITES requirements;

n.   Disposal of perishable products;

o.   Disposal of nonperishable products;

p.   Regulations for introduction into an area;

q.   Regulations for removal from an area; and

r.   Penalties for offenses.

Some examples follow:

Protected Species: A policy for protected species might include the following provisions:

(i)   Their populations are to be kept as close as possible to ecological carrying capacity, except in developed areas from which they are to be removed by translocation.

(ii)   They are only to be taken in special circumstances (e.g., for scientific reasons), in numbers that do not further endanger the population, or issue of a special license by the minister after consultation with his board; or in the event of their presenting an immediate danger to human life (but not property), in which case an immediate report is to be made to the conservation agency head.

(iii) In the event of a protected species endangering property, the agency must be notified and its representative will decide on the appropriate course of action.

(iv)   Ownership rests with the state except when specimens are transferred to individuals or bodies for special purposes (e.g., scientific) or on private land to the owner. Transfer is by order of the minister after consultation with his board.

(v)   Penalties for offenses against laws providing for protected species are relatively heavy, and take into account the financial value of the specimens of certain species.

(vi)   Export of a protected species specimen requires a certificate of ownership and an export permit.

Regulated Species: A policy for regulated species might include the following provisions:

(i)   These species are to be used for the maximum economic benefit of the people of the country, through consumptive or nonconsumptive uses.

(ii)   For each area, the intended use and hence density of regulated species in relation to their carrying capacity is specified in the master plan. In protected areas it will usually be at or near ecological carrying capacity (nonconsumptive uses), unless a lower density is required for conservation of other features (i.e., competing species or vegetation structure). Alternatively, densities may be held at economic carrying capacity for consumptive uses. In open

areas, densities may range from ecological carrying capacity to zero (e.g., for certain species in developed areas).

(iii) Off-take of regulated species will be by general license. The quotas for which will be set by the master plan.

(iv) Regulated species may be killed in defense both of life *and* property.

(v) Ownership rests with the state except on private land where it rests with the landowner.

(vi) Penalties for offenses against laws providing for regulated species are lower than for those for protected species, but still take into account the financial value of the specimens.

(vii) Export of regulated species specimens does not require an export certificate except for those species which are also *prescribed* species.

10. OFF-TAKE LICENSES:

We propose three types of off-take licenses: the special license, the general license and the supplementary license. In addition, we recommend area permits which will be required by the holders of general and/or supplementary licenses to take wildlife in certain specified areas. Fees for licenses and permits will be published annually by the minister after consultation with his board.

The special license is issued by the minister after consultation with his board in response to individual applications. Applications are assessed in relation to the benefits to the species in question and to the people of the country. The principle reason for issue is scientific. Special licenses may allow the off-take of specimens of *protected* species or of *regulated* and *unclassified* species outside the conditions specified by a general license.

The general license is intended to control off-take of *regulated* species in all areas and *unclassified* species in protected areas in the interest of good resource management and revenue generation. Quotas by species and area, methods, other rules and prices will be supplied by the master plan and published annually. General licenses are of four types: game licenses, bird licenses, fish licenses and timber licenses. The latter two refer to fish and trees under conservation agency control, but there is no reason in principle why fisheries and forestry legislation should not adopt the same system. The categorization of fish would have to be carefully examined because of the unselective nature of fishing methods.

The supplementary license is issued to authorize off-take of selected members of the *regulated* species category. Selection could be for reasons of controlling more carefully less abundant regulated species, or of levying higher fees appropriate to species that represent marketable hunts or commercially valuable trophies. Quotas will be specified by the master plan for each area.

General and supplementary licenses and area permits may be allocated according to whatever system is considered suitable by the minister after consultation with his board, for example, by first-come first-served sale, by auction, by negotiation of concessions holdable for a number of years, or by lottery (see Chapter 14).

In the case of wildlife owned by the landowner on private land, no license or area permit is required for off-take by the owner. This includes members of *protected* species, the ownership of which has been transferred to the landowner.

In the case of *unclassified* wildlife, no license or area permit is required for off-take in open areas. In protected areas, off-take would be subject to authorization by special or general license; but, see also, our remarks concerning the inevitable damage which must be sustained by minor wildlife as a result of human presence in protected areas (Section 12, below).

11. CONTROL OF OFF-TAKE BY THE CONSERVATION AGENCY:

The conservation agency may have occasion to kill or remove wildlife or other resources under various circumstances, as follows:

a. Collection for scientific purposes;

b. Culling for ecological, aesthetic or economic reasons;

c. Control in defense of life or property;

d. Killing for humanitarian reasons (i.e., to relieve pain in wounded or diseased animals);

e. Harvesting to provide rations for staff;

f. Removal for construction and maintenance, etc. (this usually involves wood, grass, stone, gravel, sand, etc.);

g. Removal of plant material for firewood;

h. Removal of dead animals (i.e., predator kills) for food, etc.; and

i. Removal of found trophies (i.e., ivory, rhino horn, skulls, skins, etc.) for scientific or economic reasons.

We recommend that the limits and conditions attached to these types of off-take and removal should be specified in the master plan and permitted

on issue of special licenses by the minister after consultation with the board to the responsible officer (i.e., park warden). Such licenses should cover the removal of all wildlife except unclassified species in open areas and all natural resources (except perhaps water, although in arid situations this might be included), within protected areas. The license for each form of off-take should specify the species or resource types covered, and the quantities, locations and methods permitted, as well as the persons authorized. The license should specify the limits of discretion and delegation permitted. Such licenses should be valid for a maximum of one year, that is, these components of the master plan should be subject to annual review (see Chapter 35).

In the cases of control, killing for humanitarian reasons, removal of dead animals and removal of found trophies, the precise situations cannot be anticipated; however, a clear set of rules should be attached to the license specifying under what conditions killing or removal is permitted, what reporting procedure is required, and what procedure for disposal of perishable and unperishable products should be adopted.

We believe that these controls are necessary to reduce the very considerable opportunities for abuse existing under most current legislation. For example, control and humanitarian shooting and removal of meat from predator kills are often used as blanket justifications for harvesting rations or revenue or for unofficial reasons.

12. DAMAGE TO MINOR WILDLIFE IN PROTECTED AREAS:

Most protected area legislation is unenforceable in that it lays an overall prohibition on killing or damaging all organisms in protected areas. This would, if rigorously applied, prevent normal management and visitor use because of the inevitable damage to minor wildlife (i.e., small plants, insects, bacteria, etc.).

Drafting legislation to cover the spirit of what should sensibly be permitted in a protected area is not easy, but we tentatively offer the following, to appear under the rules for protected areas;

> "It shall not be an offense for any person to kill, injure or disturb any wild plant less than 1 meter tall, or any wild invertebrate animal occurring within three meters of the midline of any designated road or designated trail, or within the confines of any designated campsite, management camp or utility area, or anywhere in a protected area while the said person is participating in approved official duty or in an approved wilderness walk:
>
>> 'Provided that, the provisions of this section shall not apply to any person who kills, injures or disturbs any wildlife declared to be a protected species under section. . . .'" (Conrad 1947)

This is not perfect, but it does acknowledge the fact that human presence in a protected area must inevitably result in death, injury, disturbance, albeit on a small scale, and that this should not constitute an offense. There will be loopholes, for example, when a visitor kills a dangerous snake. However, he could claim immunity under the section permitting killing in defense of life.

13. OWNERSHIP:

This is an important topic that varies greatly between countries. In many cases, the law is inconsistent and unenforceable in that the definition of wildlife embraces all wild species, no wildlife may legally be taken without a license, and ownership of the specimen depends on taking with a license. In other countries, for example Zimbabwe, all wildlife on private land is the property of the landowner.

In the Malawi draft (Clarke 1983), the position was taken that plants are part of the land on which they grow and, therefore, the property of the landowner, while animals are held in ownership by the state which, being sovereign rather than proprietorial, cannot be held liable to damage, etc., caused by the animals.

We now move to a more intermediate position, as follows. We propose that all wildlife is the property of the state except on private land. With that exception, the transfer of ownership to an individual or body depends on the wildlife type. *Unclassified* wildlife taken outside a protected area automatically becomes the property of the taker. *Regulated* wildlife becomes the property of the taker if taken under the conditions of a valid general license and area permit. *Protected* wildlife becomes the property of any body or individual by order of the minister after consultation with the board. We propose that all wildlife on private land should be the property of the landowner except *protected* species. Ownership of *protected* species, including the right of off-take without special license, may be transferred to the landowner by order of the minister after consultation with the board.

Owners of specimens of *prescribed* (*protected* and some *regulated*) species (except free-living specimens on private land) must obtain Certificates of Ownership by production of evidence of legal acquisition to the conservation agency.

14. WILDLIFE IMPACT ASSESSMENTS:

An important aspect of the category system proposed here is that species and land should be in the appropriate category. In theory, both should be under continuous review, but in practice, it will not be possible to maintain adequate surveillance in all areas. We, therefore, follow Clarke (1981) and the Malawi draft act (Clarke 1983) in proposing a provision for a wildlife impact assessment. Such assessments may be demanded by any individual whenever he has reason to believe that any activity (such as a development program, dam construction, etc.) may have an adverse effect on any population of wildlife. The government is then obliged to set in motion an assessment procedure, the end point of which is a scientific report, which has to be submitted within a specified period of time. In

the draft Malawian example, the Scientific Wildlife Board was designated the reporting agency, and the limit was 90 days. The intention is to ensure that all decisions potentially involving significant environmental impact, may be subject to public scrutiny and to take into account a scientific evaluation of the interests of wildlife. If necessary, this may allow the conservation agency to initiate the procedures for alteration of the category status of certain affected wildlife species or land areas.

15. PENALTIES:

When discussion of legislation arises, it is usually penalties that people have in mind. The primary points for consideration here are as follows:

a. Should Penalties Be Fixed By Primary Or Subsidiary Legislation?

This is, of course, a policy matter. However, fixing of penalties by subsidiary legislation has the advantage that it can be more responsive to changing circumstances, for example, the changing status of species, the real value of currency in relation to inflation and the market value of certain wildlife products.

b. Should Penalties Have Lower As Well As Upper Limits?

The Malawi draft act (Clarke 1983) recommends lower as well as upper limits for particular classes of offense. This leaves considerable discretion in the hands of magistrates, but limits the ability of magistrates sympathetic to miscreants to impose nominal penalties.

c. Should Penalty Structure Be Related To Wildlife Type and Area Category?

The category system proposed here clearly provides a good opportunity to relate penalty range to the type of offense in terms of species and area category. Such penalty grading was adopted in the Malawi draft act (Clarke 1983).

d. Should Penalty Structure Be Related To Financial Value of the Wildlife Specimens Involved in the Offense?

This is an important point frequently raised. Certain wildlife products are now so valuable that existing penalties do not act as deterrents, but can be written off as acceptable overheads. Examples are rhino horn, ivory, leopard skin, zebra skin, etc. These species fall into the *protected* and *regulated* categories. There is a good case for specifying penalties for offenses concerning trade in their products individually. The object is to render the trade unprofitable, so that for ivory, say, penalties are required which for most other *regulated* species (say sable) would be exaggerated. This was not done in the Malawi draft Act but is done in the existing National Parks Act and Game Act for Malawi in the case of rhino and elephant. The omission from the draft act was an oversight which will be amended.

e.   Should Penalties Include Confiscation of Property?

Wildlife legislation in Kenya includes a category of offense called a "forfeiture offense." Such legislation requires that persons convicted of such offenses must forfeit not only the wildlife specimens involved, but any equipment or property (i.e., firearms, vehicles, etc.) used in perpetrating the offense. Forfeiture is obligatory and is not open to judicial discretion. The Malawi draft act recommended the inclusion of this type of penalty in appropriate instances.

16. LEGISLATION--CONCLUSIONS:

Legislation is the means by which society imposes its collective will upon itself. Only legislation that corresponds adequately with that collective will is practical, enforceable and viable in the long term. Conservationists, especially those who are not citizens of the states concerned, should be cautious of imposing their value systems on societies by means of legislation proposals, unless they are satisfied that the proposals will be subject to adequate scrutiny, consultation and feedback from those who will have to live with them. In particular, they should be cautious of attempts to impose draconian penalties by means of the shortcut of subsidiary legislation. Conservation history is full of such exaggerated measures which have been steadily eroded (Graham 1973) and some of the most successful contemporary wildlife programs, for example in Zimbabwe, are based on reduction or withdrawal of legislative control. The moral is: legislation is only effective if it is an adequate expression of popular will, and the more effective it is in this sense, the less legislation is needed.

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CHAPTER 33

MASTER PLANS

BY

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1. WHY HAVE MASTER PLANS?

The master plan of a conservation agency is potentially the most important mechanism for controlling all its activities within the framework provided by government policy and legislation. In practice, however, most conservation agencies in Africa do not have master plans. We are aware of them only in Kenya, Malawi, Zimbabwe and the Natal Parks Board (Grobler 1984), the largest conservation agency in Africa, the South African National Parks Board, is only now in the process of producing its first set of master plans. Even in countries where master plans do exist, they are not always adhered to as closely as one might expect.

Why, then, have a master plan?

With or without a master plan, the operation of any organization is controlled by complex sets of interrelated decisions. The function of a master plan is to coordinate these decisions, to render them mutually compatible and to improve the efficiency of use of agency resources. A master plan serves additional important functions as follows:

a. It contains a coherent statement of the objectives of the agency and of the steps by which the agency intends to meet those objectives;

b. As such, it represents the value system of the agency;

c. It represents a statement about the environment and its future for the country as a whole; it contains a statement of conservation priorities for the country and areas in which the conservation agency intends to influence events; and

d. It represents the agency's claim on national and international resources, that is, its claim to control land and other natural resources and its claim on national and international funding; the plan is the basis of fund raising and financial control.

The alternative to working with a master plan is to work with uncoordinated components, and to be subject to ad hoc decisions and opportunistic judgments. Perhaps, most importantly, its intentions are not sufficiently stated as to be subject to public and informed scrutiny and debate. This alternative should be viewed with concern in the context of a conservation agency, the primary objective of which is to place restraints on developments based on short-term economic interests. We therefore, regard the primary value of a master plan to be that it provides a means of relating all decisions to the value system of the conservation agency in a public forum. Secondary values are that it allows the agency to integrate more effectively with other agencies, it provides a mechanism for control of agency activities, improves efficiency of use of agency resources, and assists in coordinated fund raising efforts.

2. THE COMPONENTS OF A MASTER PLAN:

The contents and status of master plans differ greatly between countries and between agencies. We intend here to outline the components

that we consider necessary to a comprehensive master plan. Readers may then decide for themselves what they consider appropriate to their situation.

We feel that a master plan should have four major aspects, namely, the constitutional aspect, the organizational aspect, the management aspect and the financial aspect. The management aspect concerns the real business of the agency in managing wildlife resources; the constitutional, organizational and financial aspects concern the means by which the agency puts itself in a position to carry out management. In relation to these four aspects, the master plan should be both descriptive (covering descriptions of the resources under agency control and past and present agency actions), and prescriptive (covering predictions and proposals for the future).

Within the framework, the master plan should cover all aspects of agency activity, as follows:

a. **Constitutional Aspects:**

   (i)   Wildlife policy;

   (ii)   Wildlife legislation; and

   (iii) A formal mechanism for producing, updating and using the master plans.

b. **Organizational Aspects:**

   (i)   Agency organization and administrative structure;

   (ii)   Manpower establishments and development;

   (iii) A master plan for each agency section (i.e., research, education, etc.); and

   (iv)   Financial control and fund raising.

c. **Management Aspects:**

   (i)   A management and development plan for each area under agency control;

   (ii)   A management plan for each major species (compatible with area management plans); and

   (iii) A mechanism for review of environmental impacts on areas and species not controlled by the agency.

d. **Financial Aspects:**

   (i)   Projection of future financial requirements;

   (ii)   Generation of revenue;

(iii)   Fund raising; and

(iv)   Financial control.

Financial aspects are not considered further in this chapter but are dealt with in a separate chapter (37).

In particular, the master plan must contain clear statements of the long-term policies and objectives of the agency for each of its areas of responsibility. If these do not accurately reflect government policy and legislation, then these must be reconciled, either by modifying agency objectives or by proposing modifications to government policy and legislation.

3.   CONSTITUTIONAL ASPECTS OF THE MASTER PLAN:

There are two basic problems with planning. The first is that, in order for plans to be useful they have to be followed. The second is that, if they are too rigid, they cannot correct mistakes or take advantage of unexpected opportunities. A master plan, therefore, needs to contain specifications as to how it is to be produced, revised and used. These specifications may be termed the constitution of the master plan. The constitution must strike a balance between opportunism and rigidity; it must be both structured and flexible, able to coordinate decisions and activities throughout the agency, while allowing for changes of policy, attitudes and circumstances, subjecting all decisions to informed scrutiny and requiring them to be mutually consistent.

In general, we feel that in most conservation agencies, it is idiosyncracy, opportunism and inconsistency that are a greater problem than rigidity. Our approach here, therefore, emphasizes methods of ensuring that master plans are actually put into practice rather than treated as pious hopes and New Year's resolutions.

Basic to our approach is the belief that master plans will only be put into practice if they correspond with the value systems of those who have to use them. They must reflect government policy and be built up on numerous agency policy decisions at all levels. Producing a master plan is, thus, in no sense a separate part of the business of *the* agency, to be carried out by a specialized section or officer. It is essentially the business of the agency, and the initiative must come from the top and the appropriate decision makers at each level. The agency should not set up a planning section and say: "Give us a plan." The agency directorate must create its own policy structure and then hand it to the planners and say: "Fill in the nuts and bolts." It is essential that decision makers should not feel that policy is being imposed on them by planners; if they do, they will actively or passively reject the plan. However, planners do not always find it easy to extract the necessary policy decisions from the appropriate authority.

For this reason, it is desirable to set up a formal mechanism for production, revision and use of the master plan. Such a mechanism is used by the Natal Parks Board and by the Department of National Parks and

Wildlife Management, Zimbabwe (Cumming 1983). It is an important aspect of the overall organizational structure of the agency.

In the last chapter, we have recommended that the primary arbiter of agency policy should be the responsible minister after consultation with a Scientific Wildlife Board. The minister is not obliged to accept the decisions of the board, but all policy decisions must at least be subjected to its scrutiny. We have recommended that the board be constituted in such a way as to embody the highest available level of technical and ethical competence with respect to conservation and wildlife management. We anticipate that, in most African countries, this will be centered in the conservation agency itself. We, therefore, recommend that the board consist of the minister or his representative, the agency director, and agency staff of senior professional officer rank. In large agencies, it might be necessary to limit membership to, say, the six most senior staff members, but ensuring representation of all regions and major agency sections. In addition, the board would include nonagency representation, for example, of the agency responsible for antiquities, the national university and voluntary conservation bodies. It is important, however, that the board should be dominated by professional wildlife managers (i.e., agency staff), rather than by amateurs from outside bodies.

The primary feature of the master plan constitution should be that the minister after consultation with the board should be responsible for producing, revising and putting into practice, the master plan. This feature should be embodied in primary legislation. As a result of the adoption of the master plan (or of a revision of it) by the minister after consultation with the board, the contents of a range of regulations would be defined, such as the objectives for particular areas and, hence, the permissible uses of wildlife resources in them, the categorization of wildlife species, culling and other off-take quotas, details of licenses (i.e., prices, rules, etc.), and financial estimates, etc. Thus, the master plan acquires the status of subsidiary legislation in at least some of its aspects.

How is the master plan to be produced?

To some extent the answer depends on the size of the agency. Especially the master plan components should come from the integrated management team (at the appropriate level) for each area and from the head of each agency section for that section's activities. Section plans and area plans must of course be compatible, and this leads on to the question of dual control of specialist staff which will be discussed below. It may be necessary in a large agency to have a multitiered planning hierarchy, with the agency directorate and board at the top, regional management team in the middle and area management teams at the bottom.

It may be useful to have a specialist planning section, whose task it is to work with the planning hierarchy and to use its input to put the necessary information into the required format. This section would provide technical advice on specialist topics such as computer modeling of financial plans, site planning and design. The planning section should be regarded as providing a technical service, not in any sense as the body responsible for generating the plan.

It is also important to define what levels of activity are obligatory as specified by the master plan and what levels are left to the discretion of management teams. These definitions of discretion may be incorporated in the master plan itself and be subject to review. They will depend on the size of the organization, the degree of centralization of government structure and the quality and experience of agency staff. For example, in a small centralized situation, like Malawi, very little is left to the discretion of area teams and no permanent structure or road may be initiated or staff employed without written authority from the agency directorate. In countries with a more decentralized government structure such as Botswana, the agency directorate might provide policy guidelines and a financial ceiling while details of zoning, use and development might be the responsibility of district management teams.

The important point is that, whichever level of the planning hierarchy supplies the contents of the master plan at each level of detail, once the contents have been approved at the specified level (usually by the minister in consultation with the board), then those plan contents should be binding until revised through the same planning process, unless the plan itself specifies discretion. We contend that, without such a degree of formal structure, master plans can be too easily submerged by ad hoc and opportunistic decisions; they become New Year's resolutions that are not kept.

Such a formal structure requires a regular process of review so that the plan can keep pace with events. Clearly, different components of the plan need review on different time scales. We suggest the time scales should be five-year, one-year and occasional. Thus, each component should contain a specification for review frequency (as in aircraft maintenance schedules) and should be reviewed at least at that frequency. However, any member of the board should have the right to introduce an occasional review of a particular component at any time. For example, the policy and objectives of each protected area might be specified as required review at five-year intervals, while culling quotas, hunting quotas, species categories, etc., would usually require annual review. However, construction schedules might need review outside the annual or five-year review intervals because of unpredictable price increases, etc.

The provision in the proposed legislation (Chapter 34) for Wildlife Impact Assessments (which may be demanded by any number of the public in the event of any potential environmental threat due to a development project) and for production of a master plan for any newly acquired protected area within a year of acquisition, can both be regarded as components of the reviewing process. This is because the master plan covers the whole country, so that the intensifying of management as a result of a wildlife impact assessment or of acquisition of a protected area does not require production of a new master plan for the area in question, but a revision of the existing one. In both cases, the situation calls for an obligatory occasional review, required by primary legislation in the event of a public demand or of a change in land category respectively.

Considering the logistics of the board meetings, it is probably desirable that a full board meeting should be required at least once a year

to review the regular annual and five-year components of the master plan. However, it should be noted that a high proportion of board business and the review process can be carried out by mail, simply by circulating plan components for review.

4.   ORGANIZATIONAL ASPECTS (A)--AGENCY STRUCTURE:

An important component of the control of an agency's activities is its organizational structure. Here again, there is wide variation around Africa depending on agency size, organizational history, etc. For example, the ex-French countries have characteristically different organizational structures and approaches to wildlife management from ex-British countries.

We do not intend here to assert the superiority of any particular organizational structure. We would like to discuss a problem that confronts most organizations, that is, the relationship between general management and specialist or technical services. In conservation agencies, we are primarily concerned with the relationship between area management and the specialist sections, i.e., the management, research, education and public relations, tourism, wildlife control, and training sections, etc. Conflicts between sections, particularly between research and management, have a long and colorful history in African conservation.

We would like to recommend for attention the concept of dual control as a solution to this problem of organization (see also Chapter 7 on Research Priorities). In this system, the basic management unit is an integrated management team consisting of members of each of the specialist sections required in a particular area, particularly management, research, wildlife control and public relations. Such teams should exist at each hierarchic level, the top level consisting of the Scientific Wildlife Board, descending through Regional teams to area teams as required. Each team should have an identified responsible leader. With the increasing professionalism and common training of staff, there is no reason why the team head should always come from the management section. The leader should be appointed on seniority and merit.

At the same time, the specialist sections require distinct organizations to cater to particular requirements in recruitment, training, equipment, supply and specialist services, etc. Thus, each section needs its own administration and financial allocation. However, the job of each section is not to run an isolated mini-empire, but to provide a service and to supply trained and equipped specialist personnel to the management teams. Thus, when a specialist section (i.e., research) puts an officer into the field, he becomes part of his area management team and is responsible to it. However, the team may apply to the parent section head for advice and services. It is also the parent section's responsibility to ensure supply of appropriate junior staff, equipment, etc. The section head's main avenue of control over his subordinate's activities is through his membership of a higher level management team which allocates funding and work priorities to the lower levels.

Thus, each officer is subject to dual control, from his management team and from his section head. This is by no means a novel concept and was the basis of the British colonial administration with its district

teams headed by the District Commissioner. A similar structure has been adopted by many independent African countries as the basis of their local administration. Perhaps most significantly, as an indicator of efficiency under pressure, the dual control system is widely used in military organizations, where specialist arms such as artillery, armored or air forces are developed by a specialist parent service, then allocated for tactical control to an integrated force under separate control. The system of dual control is well described in the case of the Soviet armed forces by Suvurov (1982).

A further point to note is a trend towards reducing the distinctions between staff of specialist sections, as a result firstly of equivalent professional background and training of staff from all sections, and secondly of the emphasis on adaptive management, which blurs the distinction between management and research. For these reasons, there is a case for periodic rotation of staff between sanctions and the dual control format is well adapted to this situation, since the tendency will be for all staff to become all-around professionals. This point is expanded in Chapter 7.

5. ORGANIZATIONAL ASPECTS (B)--MANPOWER DEVELOPMENT AND CONDITIONS OF SERVICE:

The development of trained, professional manpower is probably the single most important factor in ensuring the effectiveness of a conservation agency (or any other kind of agency). Without competent manpower, nothing can be achieved, however much funding and equipment is available. But, highly motivated, competent staff can achieve a great deal on very limited resources. Manpower development and conditions of service are, therefore, a vital aspect of conservation agency master plans. Certain aspects of conditions of service are discussed in more detail in the next chapter.

The master plan should specify the required density and location of staff. It is possible, for example (see Chapter 22), by monitoring of illegal activity and law enforcement, to estimate the required density of patrol staff for a particular area. In Malawi, a general figure of 1 Game Scout per 50 km^2 has been adopted; however, higher densities may be required where an attractive target of high conservation priority (i.e., rhino, gorilla) is at risk. It is also necessary to calculate the required density of tourist guides and interpretive staff so that the use of field staff for this purpose does not erode law enforcement capability. This point will be enlarged when discussing tourism (below). Further aspects of conditions of service are dealt with separately in Chapter 36.

A key factor in manpower development is training. Three levels of training are required, at senior, middle and junior levels, with opportunities for upward mobility to ensure viable career structures. The importance of training can hardly be overemphasized, both as the means to ensure competence, and, perhaps even more importantly, as the main means of transmitting the conservation ethic to each generation of staff.

At present, most senior staff training is carried out externally, either overseas or at a regional college such as Mweka (Tanzania) or Garoua

(Cameroon).   Similarly, few countries have well developed facilities for middle and junior level training, which is usually carried out at regional colleges or in service.

We feel that regional training centers, particularly at the senior level, have many advantages, both in making economies of scale and in developing a regional network of professional colleagues, a great asset in regional cooperation.   However, we feel that, at all levels, a critical examination of training curricula needs to be carried out to develop training programs of optimum usefulness. This is a complete subject in its own right, but we feel that curricula should be based on developing a set of integrated adaptive management procedures that are related to the operational structure of each conservation agency.   Briefly, we feel that formal training at training facilities should be an integral part of agency practice,   so   that   training   curricula   and   agency   organizations   and procedures need to be developed simultaneously.   Training curricula, particularly at national facilities, should, therefore, be part of the master plan and developed and approved by the planning hierarchy as with other components of the plan.

6.   MANAGEMENT ASPECTS (A)--AREA AND SPECIES MASTER PLANS:

We consider now those components of the master plan concerned with the management, use and development of particular areas and wildlife resources. Such plans contain the essence of conservation activity; they spell out the agency's value system and the means by which it is to be realized.

The first requirement is for a national wildlife strategy which answers the questions:

Which wildlife does the state want?

Where does it want it?

How much does it want?

How does it want to manage it?

The national wildlife strategy should, of course, be part of a national land use strategy, if such exists.   Such a strategy should allocate priority by area to the various alternative land use interests such as agriculture, livestock, forestry, fisheries, wildlife, etc.

The conservation agency should attempt to obtain priority for wildlife in high conservation value areas but must recognize that in certain circumstances it is impractical or undesirable to attempt to retain control over wildlife resources. The importance of developing an integrated land use strategy in which the role of wildlife is clearly defined has been amply demonstrated by the conflict over the reduction of wildlife populations in Botswana as a result of partitioning of migratory range by veterinary fences (Williamson 1983).

The primary division of land categories from the conservation point of view is between protected areas in which agriculture, livestock management

and settlement are restricted and in which most resource use is under conservation agency control, and open areas in which no such restrictions exist. In open areas, the conservation agency will usually have less control over resource use, and its master plan must accommodate itself to the status quo or the plans of other agencies, unless high conservation priority features indicate that effort is required to transfer parts of the open area to protected area status.

Within each of the two major land use categories, protected and open, it is useful to delineate zones which differ with respect to management objectives. The definition of the objective for each zone is of primary importance. In some master plans, objectives are stated in rather imprecise terms that allow a wide range of interpretations and, hence, render them vulnerable to decisions that do not correspond with the original intent. Any definitions that depend on the concept of "the natural" are of this type, and cannot be meaningfully used in conservation planning (Bell 1983); the same is true of definitions couched in such terms as "little development as possible," and so on.

We argue that the only rigorous method of defining management objectives is in terms of limits to permissible change, preferably expressed quantitatively. This approach was initially used by Bell and Mphande (1980) and the logic was discussed by Bell (1983). It was used as the basis of resource management planning in the Malawi Master Plan (Clarke 1983a, b, c and d).

The concept is simple; it is that the object of conservation (or indeed any other type of land use planning) is to ensure that various specified parameters of the environment remain within particular limits. The range of permissible values between the limits may be narrow, specifying a relatively static state or wide, permitting a range of processes and component trajectories, or the limits may be specified as continuously changing, requiring a trend in the environment or some part of it. The essential point is that the agency commits itself to a management program that retains the ecosystem components within the permissible limits to change.

Originally, this approach was applied only to ecological aspects of the environment, i.e., plant and animal densities (Bell and Mphande 1980). In the Malawi Master Plan (Clarke 1983), the objective for each area was specified in three ways: (examples are quoted from the master plan for Kasungu National Park (Clarke 1983c)).

Firstly, the overall objective for each protected area was identified in an introductory paragraph as follows:

a.   The reasons for having and managing national parks and game reserves are stated in the principal master plan (see statement of policy, Chapter 33, this volume).

b. The specific objectives for Kasungu National Park are as follows:

  (i)   To preserve examples of the major biotic communities named in the descriptive part of the master plan including their associated faunas.

  (ii) To protect the aesthetic values of the park and areas of special interest named in the descriptive part of the plan.

  (iii) To offer special protection to the species listed as rare, endangered or endemic in the descriptive part of the plan.

  (iv) To protect the upper catchment of the Dwangwa River and part of the catchment of the Bua River, so as to assist in maintaining water supplies to adjacent agricultural land in Central Region, and for the betterment of fish conservation and fisheries management.

  (v)   To provide for legal, public use and enjoyment of the parks' resources, subject to the limitations laid down in the policy statement (Chapter 33).

c. Public uses of Kasungu National Park may include all forms of approved (listed) nonconsumptive use, plus licensed angling and licensed commercial honey gathering. (In Nhotakota Game Reserve, however, permissible consumptive uses include licensed hunting, fishing, timber extraction and honey gathering for subsistence or commercial purposes, and licensed gathering of other forest products for subsistence purposes.)

d. Indigenous wood may be gathered within the park for domestic heating purposes in management and visitor sites, and for management construction and maintenance work, provided that economical alternative supplies are not available. This concession is subject to the limitations laid down by the policy statement (Chapter 33) and to the limits of acceptable woodland structure defined below not being transgressed. It is also subject to written authority of the Chief Game Warden which shall have effect for not more than one year at a time.

Secondly, the permissible limits to change of biological resources were laid down for a series of management compartments as follows:

a. **Northern Compartment:**

The overall objective is to maintain mature woodland structure for relatively high densities of specialized woodland antelopes (Lichtenstein's hartebeest, sable, roan) and for landscape aesthetics, both for nonconsumptive uses (tourism and genetic conservation).

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(i) **Brachystegia woodlands** should be managed so that:

    (1) recruitment of trees to height classes greater than 10 m does not fall to a negative value over more than 20 percent of the compartment; and

    (2) density of stems less than 3 m tall does not exceed 150 percent of the present value over more than 20 percent of the compartment.

(ii) Valley woodlands: no limits specified.

(iii) Elephant is the key species. The management aim is to maintain a relatively small population so as to perpetuate the woodland's mature character. The number of elephants in the compartment should be maintained between 100 and 500 (0.1 to 0.5 per km^2).

(iv) If objectives (i) and (iii) conflict, (i) has priority and (iii) should be revised.

(v) Other large herbivores. The initial objective is to achieve populations that are 80 percent of estimated ecological carrying capacity (i.e., by reducing illegal off-take) and, thereafter, maintain them at or above 80 percent. (Note, this gives an indication of the tolerable level of illegal off-take, which will in turn determine effort and expenditure on law enforcement.)

b. Central Compartment:

The overall objective is to maintain a high density of elephant for nonconsumptive uses (tourism, genetic conservation).

(i) **Brachystegia woodlands:** no limits specified. (Note, in this area, woodlands respond to elephant attack by coppicing so that inaction is not likely to lead to an elephant crash, see Chapter 10. In other circumstances, maintenance of a high elephant density might require culling.)

(ii) Valley woodlands: no limits specified.

(iii) Elephant is the key species. The management aim is to maintain a relatively high population for visitor viewing and genetic conservation. The initial objective is to achieve population of 1,200 (by reduction of illegal off-take and crop protection shooting) and, thereafter, to maintain it between 1,200 and 1,500 (i.e., 3 to 3.75 per km^2). This range is estimated to be about 80 to 100 percent of carrying capacity.

(iv) Other large herbivores. The initial objective is to achieve populations that are 80 percent of estimated carrying

capacity and, thereafter, to maintain them at or above 80 percent. (Note that the carrying capacity of coppiced woodland for the woodland antelopes is considerably lower than that of mature woodland, Bell 1981.)

Three points should be noticed about this method of defining management objectives for biological resources. Firstly, the objectives chosen from the class of technically sound options are chosen by means of subjective value judgments or aesthetic decisions (Bell 1983). Secondly, it must be emphasized that the limits to permissible change depend on a minimal level of inventory and monitoring capability. The form of the statement of objectives must be related to this capability. Further, the limits specified are not magic numbers. They are empirical rule of thumb estimates. They are subject to revision as the agency's management and research capabilities evolve. The significance of the system is that it sets out to prescribe quantifiable and objective limits as an alternative to subjective concepts of naturalness which are immeasurable and often misleading. Thirdly, it should be noted that the habitat limits listed above specify an essentially static woodland structure. In many African woodlands, this may be unrealistic and the permissible limits may have to be tailored to cater to a phased community structure in the form of a dynamic mosaic.

Thirdly, the permissible forms of infrastructure development were specified for a series of zones for each protected area. A zoning system appropriate to Malawi circumstances was devised that differs somewhat from those in use in North America (see Forster 1973). Zone definitions were as follows:

a. **Special Areas:**

    Purpose: To protect sites that have unique, unusual or otherwise important biotic or abiotic features.

    Size: Variable.

    Management Strategy: Protect. Carry out restorative work if needed to perpetuate the inherent character of the site.

    Permitted Development: Trails, minor interpretive displays and animal viewing hides.

    Entry Restrictions: Nonmotorized only. Daylight hours only and no overnight stays.

b. **Wilderness Areas:**

    Purpose: To provide large tracts of relatively undisturbed land for scientific study and wilderness experience.

    Size: 25 km^2 minimum.

Management Strategy: Manage to achieve purposes without the use of motorized surface transport, and without leaving permanent traces except for those listed against permitted development.

Permitted Development: Trails and nonpermanent campsites, the latter not to exceed 0.25 hectares each.

Entry Restrictions: Nonmotorized only. All equipment and supplies to be carried in and out. All nonburnable rubbish to be carried out.

c. **Semiwilderness Areas:**

Purpose: To provide tracts of relatively undisturbed but accessible land for scientific study and semiwilderness experience.

Size: Variable.

Management Strategy: Manage as main locations of vacationing visitor use, keeping the areas as little disturbed as possible commensurate with this. (Note the difficulties attached to this type of definition which allows a wide range of interpretation.)

Permitted Development: Trails, roads, firebreaks, picnic sites, minor interpretative displays, animal viewing hides, minor management camps and limited accommodation camps. A minor management camp accommodates not more than ten management personnel and not more than 40 persons in total. A limited accommodation camp is a noncatering visitor amenity that sleeps not more than 16 visitors.

Entry Restrictions: Motorized or nonmotorized, but the former is restricted to roads and navigable waterways.

d. **Utility Areas:**

Purpose: To provide sites for management and visitor purposes. They include airfields.

Size: 200 hectares maximum. The total for any one park or reserve is not to exceed 500 hectares. No utility area is to extend further into a park or reserve than 1 km.

Management Strategy: Manage for purposes stated above but aim to minimize impacts on inherent park or reserve values. In the current master planning exercise, utility areas are designated around existing utility amenities. Thereafter, all new utility areas will be designated only in areas that are adjacent to park or reserve boundaries. Future planning will:

(i)   Ensure that no existing utility area not adjacent to a boundary is increased in size, even though this may not extend it beyond the 200 hectare limit; and

(ii) Seek ways of diminishing or extinguishing utility areas that are not adjacent to park or reserve boundaries.

Permitted Development: Subject only to design criteria laid down from time-to-time by the department.

Entry Restrictions: Subject only to criteria laid down from time-to-time by the department.

In addition to the above zoning scheme, we have concluded that it is desirable to add a waiver to protected area legislation to cater to the unavoidable damage to minor wildlife associated with management and visitor use, see Chapter 24, Section 11.

7. MANAGEMENT ASPECTS (B)--ZONING AND CONCLUSIONS:

The last section summarizes the zoning format used in the Malawi Master Plan. However, we feel that it is useful here to propose a more general framework for zoning to render it more flexible for use outside Malawi's particular situation.

We suggest that each zone should be defined in relation to four aspects as follows:

a. The permissible limits to change of physical and biological resources;

b. The permissible forms and agencies of use (i.e., tourism, hunting, timbering, etc., by the agency, licensed hunters, tourist concession, the owner, the general public, etc.);

c. The permissible types of infrastructure development; and

d. The permissible amounts of settlement, agriculture and livestock management.

The last aspect is usually the most important and will usually be controlled by primary legislation. The other three aspects can be regulated by subsidiary legislation as specified on a reviewable basis by the master plan.

The permissible values of the sets of environmental parameters are now set on the basis of a four-dimensional matrix. This may seem rather complicated but it is, in fact, what happens in most cases. Such a system allows various aspects of management and use to be modified independently even though they may be linked. For example, it may be desirable in a particular area to regulate the phasing of the plant-herbivore interaction by means of culling and no-culling zones, as in Umfolozi Game Reserve, Natal (MacDonald and Brooks 1983). Such wildlife density zones may be overlapped by wildlife utilization zones (i.e., sport hunting or no-sport hunting zones) as in Pilansesberg Game Reserve, Bophuthatswana (Anderson 1983). Both the former types of zones may be overlapped by infrastructure development zones (as in Malawi's Game Reserves, Clarke 1983). Finally,

all the former aspects of zoning may have to be related to existing and potential agricultural, pastoral and settlement patterns, as in the Luangwa Valley Game Management Areas (see Dalal-Clayton 1983). Such a four-dimensional zoning system is being applied (in fact, if not in theory) to the new Lake Malawi National Park. Here, a complex zoning system has grown up to regulate the intensity of conservation of the highly diverse endemic fish populations, consumptive uses by a range of potential users including traditional fishermen, commercial fishermen and the aquarium fish trade, nonconsumptive uses by conventional tourism and wilderness trails, and the zoning of the land area for settlement, agriculture, forestry production and various tourist uses. A similar system was proposed by Dirschl (1967) for the Ngorongoro Conservation Area, Tanzania.

This multi-aspect approach to zoning could provide the basis for rotational zoning in which some or all aspects of the zones are rotated to take advantage of the ecological influences of certain use types on the mosaic dynamics of the ecosystem. This is an interesting and intellectually attractive idea that has been proposed from time-to-time, for example, by Verboom (1968) for the Luangwa Valley, Zambia, by Bell (1971) as a general proposition, by Kandawire (1981) for the lower Shire Valley, Malawi, and by Abel (unpublished) again for the Luangwa Valley. While rotational zoning is an attractive concept ecologically, it presents many practical, political and economic difficulties and has not, so far as we know, been put into practice in Africa.

In constructing a zoning system, the first step is to carry out a landscape classification of the area in question (see Chapter 8). This is because the ecological situation, the potential for most forms of consumptive and nonconsumptive uses, and the problems and costs of infrastructure development are landscape-related. For example, Dalal-Clayton, et al. (1983) point out that integration of wildlife uses in the Luangwa Valley with settlement and cultivation is largely controlled by landform. Similarly, Ian Parker (Chapter 18) has emphasized the importance of wildlife densities and terrain accessibility on the feasibility of culling. Conventional tourism also depends heavily on wildlife density and landscape aesthetics as well as terrain accessibility. Wilderness trails are more suited to areas with high local patchiness (such as the Luangwa Valley) than areas of relatively uniform habitat (i.e., the Serengeti Plains). For this reason, the Malawi Master Plan contains a landscape classification of each protected area which is regarded as the basis for area management plans and for zoning.

To conclude this section on zoning, we note that experience has shown that zoning, both in the geographical demarcation of zones and in the definition of permissible uses, is one of the components of master plans that is most vulnerable to ad hoc and opportunistic decisions, particularly in response to economic pressures. This is a matter of considerable concern. For this reason, we have emphasized the need to formalize the conservation ethic in a constitutional form through which decisions are subject to discussion and scrutiny by a professional cadre and which are binding until revised through the same process.

8. MANAGEMENT ASPECTS (C)--TOURISM:

We include a short section on tourism since this is an important aspect of protected area management not dealt with elsewhere in this volume. Our object here is to sound a note of caution. (Much of what follows is based on Carter 1985.)

Tourism has long been regarded as the universal panacea of the problems of conservation; it will generate revenue that will cover the costs of conservation and it will generate international interest and stimulate the flow of aid funds to conservation. Tourism is, thus, frequently regarded as *the* justification for conservation.

We regard this as an undesirable and potentially counterproductive outlook for three reasons: firstly, because in most African countries, wildlife-related tourism does not, and is unlikely to, generate significant revenue; secondly, because in order to create the infrastructure needed to develop an economically significant tourist flow, habitat modifications may be required that are inconsistent with the objectives of conservation; and thirdly, any justification of conservation on the grounds of economic returns renders conservation vulnerable to more immediately profitable forms of land use (Clarke 1972).

The potential for tourism of an area depends on five main sets of factors:

a. The accessibility (in terms of time, cost and comfort of travel) of the area to sources of potential tourists, most of whom are relatively affluent members of industrialized societies;

b. The recreational value of the area in terms of wildlife sighting rates, landscape aesthetics, etc.;

c. The facilities available, i.e., accommodation, roads, recreational opportunities, guides, information, etc.;

d. The management policy of the area which may place constraints on facilities and use patterns; and

e. The actual or perceived civil security of the area.

It is probably fair to say that there are currently only three or four countries in Africa (i.e., Kenya, Zimbabwe and South Africa and possibly Botswana) where these factors combine to render wildlife-related tourism an industry that generates significant revenue and comes close to justifying the costs of conservation.

The first point to emphasize is that tourism is primarily a practice of the urban middle class, which in independent Africa is predominately expatriate. In Malawi, expatriates make up about 0.25% of the population, but account for 92% of paying visitor days to the national parks by Malawi residents (Carter 1985). The balance of nonresident paying visitors are, of course, all international visitors of the same type so that Malawian

residents account for about 1% of all visits. This situation is typical of African wildlife-related tourism. It is primarily due to the low incomes of most African nationals in relation to the relatively high costs of transport, accommodation and park entrance.

The disadvantages of such a skewed participation in tourism are obvious: firstly, the industry is based on an external market which in Africa is usually distant and affected by external factors such as the economic situation in source countries and travel prices; and secondly, it is likely that local residents will regard conservation areas as the exclusive preserves of wealthy foreigners. For these reasons, we advocate emphasis on developing tourist facilities appropriate to local nationals, with low cost accommodation and public transport. Low rates for entry by country nationals or residents are now commonly in use. It may, at least initially, be desirable to adopt a policy of subsidized tourism for country nationals as an extension of the education/information program.

The second point concerns recreational value. It is important to be aware that recreational value varies greatly between areas and is landscape related depending on wildlife densities, type and visibility as well as vegetation type, landscape aesthetics and climate. It is probably fair to say that Africa's most attractive wildlife-related tourist destinations are associated geographically with the eastern African rift valley system with its high wildlife densities, open vegetation, spectacular scenery with frequent mountains, rivers and lakes and moderate climates. Basement areas, which make up the majority of the continent, tend to be less attractive in these respects, and, though interesting to specialists and containing attractive individual locations, are unlikely to form the basis of extensive tourist industries.

The third set of factors is available facilities. This is, of course, the principal set that is subject to planning and development. Here, it is usually necessary to treat the wildlife-related tourist industry as a component of the overall national tourist situation taking into account accommodation, transport, information and promotion at a national level as well as strictly in relation to protected areas. It is also important, in any economic analysis of tourism, to clarify which costs of conservation are to be accounted against tourism, i.e., what proportion of the costs of conservation agency administration, law enforcement, infrastructure development and maintenance, interpretive facilities and staff, etc., as well as the direct costs of tourist accommodation, facilities and staff are to be costed. In Malawi, tourism is given low priority as a justification for conservation (Chapter 33) so that a correspondingly low proportion of conservation costs are attributed to it.

Nonetheless, we argue that in a high proportion of cases, a rigorous analysis of the financial costs and returns from wildlife-related tourism will indicate that tourism operates at a loss to the conservation agency. The basic problem is that the high costs of installation and running of tourist facilities require relatively high occupancy rates to cover costs; whereas, the small size and strongly peaking nature of the market make for very inefficient use of the investment (Carter 1985). Four factors may be pinpointed as being particular sources of economic problems in African wildlife-related tourism:

a. The Unevenness of Tourist Use of Many African Protected Areas Both in Time and Space:

Many areas are inaccessible during the rains, which severely curtails tourist use for five to seven months of the year. Similarly, wet season viewing is often poor even when access is not limiting. Many areas rely on a small professional class of customers who normally visit protected areas in their free time, producing sharp utilization peaks at weekends and public holidays (Carter 1985). In spatial terms, tourists tend to concentrate strongly on certain amenities such as predators (Henry 1980) or certain routes which have high animal sighting rates. For example, in Kasungu National Park, 50% of all tourist driving is carried out on 5% of the road system (Bell, unpublished data; Carter 1985). This temporal and spatial "peakiness" of visitor use is characteristic of African wildlife-related tourism and it leads to inefficient use of investments such as accommodation, roads and staff. Tourism planning should concentrate on reducing peakiness and amenity bottlenecks, and ensuring an economic balance between facilities related to these bottlenecks.

b. The Cost of Roads and Motor Transport:

Conventional wildlife-related tourism relies on motorized game viewing on roads or tracks. Road construction and maintenance are expensive and are increasingly becoming a constraint. Similarly, the costs and availability problems of fuel for motorized tourism have escalated in the last five years in some countries, leading to significant reductions in tourist traffic (Carter 1985). We feel that the emphasis in tourism planning should be on uses that rely less on driving, that is, on wilderness trails, viewing hides, and particularly, the attracting of wildlife to utility areas by waterholes, fertilizer, etc., using what may be called the *treetops* approach. This not only is more efficient economically, but it sequesters tourists in small locations, thus, limiting the conflict between conservation and economic objectives.

c. Refrigeration:

This is a chronic problem faced by all fully catering facilities since it is required for food storage. The traditional solution has been electric deepfreezes operated by generators which have to be run even at low occupance periods. This is the single largest overhead in many African wildlife lodges. New technology should solve this problem, using solar power and ultralow temperature refrigeration. However, most planners are not aware of these options, which, although expense to install, nonetheless with current fuel prices, will usually cover their costs in a short time.

d.   Tourist-Related Staffing:

In less developed protected areas where visitors require guides and/or guards, staff availability may be a limiting constraint. Again, the problem is exaggerated by the peakiness of the traffic (i.e., dry season, public holidays, weekends) (Carter 1985). This is usually catered to by taking management staff off other duties such as law enforcement. In this case, it should be costed against tourism and may render the exercise financially inviable.

The fourth set of factors concerns management policies. The conservation agency may decide to impose limits (either overall or by zone) on the amount and type of tourist use. There are two reasons for imposition of such limits. Firstly, certain levels and types of tourism may be seen to conflict with the conservation objectives of the zone. This is the basis of the development zoning described in the last section. Secondly, tourist density and activity may be limited to protect the quality of the recreational experience itself. Such considerations require the setting of "carrying capacities" for visitors (perhaps, better termed "visitor capacities" to avoid confusion). Guidelines for setting of visitor capacity limits are given by Tivy (1972), Burton and Muir (1974), Lawson and Baud-Bovy (1977) and Carter (1985). Visitor capacity limits are based on "ecological" considerations, that is, the physical impact of visitor use on the environment, and "aesthetic" considerations, that is the effect of visitor density on visitor enjoyment. It should be noticed that both these sets of factors differ considerably in relation to the type of tourist involved and the level of infrastructure development. The point to emphasize here, however, is that tourism and conservation have objectives which are to some extent incompatible so that the full realization of one may compromise the realization of the other. The pragmatic solution to this problem is through zoning.

The fifth set of factors concerns the perception by potential tourists of the civil security situation in destination countries. This can be a major constraint on international tourism and tends to be rather unspecific, that is, civil disturbances in one country may affect the tourist flow to other countries in the region since potential tourists rarely possess detailed knowledge of local conditions.

In devising a master plan for tourism, therefore, four primary questions need to be answered:

a.   How many tourists of each spending bracket would in fact be potential customers given the development of certain types of facility?

b.   What limits to this potential tourist flow are to be imposed by agency management policy in terms of overall limits and zoning?

c.   Given the potential flow and the management constraints, what are the financial implications of different levels of facility development? and

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d.   What policy choices will be based on these implications? To what extent are certain types of tourism to be subsidized, and to what extent are conservation objectives to be compromised to maximize revenue generation?

Of these four questions, the first and third are technical and can potentially be answered by economic analysis. However, the second and fourth questions relate to policy and the answers will be based on subjective value judgments or aesthetic decisions (Bell 1983). It is important to recognize that the answers to these two questions cannot be derived from cost-benefit analysis. The reverse is true; the results of cost-benefit analysis depend on the results of these policy decisions. However, there may be feedback in that the policy decisions may be revised in the light of cost-benefit analysis results.

We conclude that wildlife-related tourism is usually less profitable economically than is often assumed and that this usually emerges from rigorous cost-benefit analysis. A similar conclusion was reached by Parker (1980). There are, of course, exceptions to this, particularly in areas of high amenity value, well-developed infrastructure and accessible affluent markets. In other situations, most wildlife-related tourism is probably subsidized, intentionally or unintentionally. This is not necessarily undesirable from a conservation point of view since it keeps conservation areas in the forefront of public attention. We feel that serious efforts should be made to involve local national communities in wildlife-related tourism even at the expense of increased subsidization.

9.   MASTER PLANS--SUMMARY AND CONCLUSIONS:

With or without a master plan, the operation of any organization is controlled by complex sets of interrelated decisions. The function of a master plan is to coordinate these decisions to render them mutually compatible and efficient in the use of funds and other resources, and to clarify future requirements and allocations of resources. Most importantly, master plans provide a means by which all decisions are subject to informed scrutiny, thus, reducing the entropic tendencies of individual idiosyncracy, ad hoc decisions and opportunistic judgements.

The process of producing master plans is essentially an interactive process between technical personnel generating the classes of technically sound options and policy makers selecting particular options from these classes. As Bell (1983) has emphasized, the selection of a particular set of options is based on subjective value judgements or aesthetic decisions. The policy judgments that determine the form of a master plan cannot be derived from quantitative technical procedures such as cost-benefit analysis or environmental impact analysis. Rather, the opposite is true; the results of such technical analyses depend on the choice of policy options. However, feedback may take place by which policy decisions are reviewed on the basis of technical analyses. This is the feedback channel that embodies the adaptive management concept, and as has been emphasized throughout this volume, it should be built into each agency procedure at each level.

We have identified four main aspects of master plans, as follows:

a. Constitutional aspects;

b. Organizational aspects;

c. Management aspects; and

d. Financial aspects.

This paper deals with the first three; financial aspects are covered in Chapter 37.

We have placed emphasis on the constitutional aspects of master plans because in our experience, without them, master plans have the status of New Year's resolutions to which lip service only is paid. We contend that, to fulfill its functions, a master plan must accurately represent the policies and outlooks of those who have to put it into practice and it must be binding. In short, the master plan should have the status of an internal legislation of the agency and it should integrate with national legislation by providing the contents of subsidiary legislation. We propose that the master plan should be generated by area, regional and national management teams with technical assistance from a planning unit. It should then be adopted by the minister after consultation with the scientific wildlife board, after which it acquires the status of subsidiary legislation and is binding until modified by the established review procedure. Each component of the plan should have a specified review interval (i.e., one-year, five-year), while any member of the board may call for an occasional review of any component. When a component is subject to review, the options are generated, an option is selected and the selected option becomes binding until further review in the same way.

Under organizational aspects, we advocate an agency structure related to the constitution described above, with the additional feature of dual control of each staff member. The basic management unit at national, regional and area level is the management team consisting of members of appropriate specialist sections (i.e., management, research, control, education, tourism, etc.). Each team generates its master plan and work programs and carries out its activities as an integrated unit. However, each specialist section has special requirements of recruitment, training, equipment, supply and specialist services. These are provided by the specialist sections to their members who are also members of management teams. Each staff member is, therefore, subject to dual responsibility to his management team and to his specialist section. We believe that this system would increase efficiency of integrated action and reduce conflicts between specialist sections.

Management aspects cover the essential business of conservation activity. We advocate the compilation of master plans by area and for key species. The two must, of course, be compatible. Our discussion concentrates on area master plans.

Area master plans should be hierarchic, starting with a national wildlife strategy, which should be an integral component of a national land use strategy. It should answer the questions: which wildlife does the state want? Where does it want it? How much does it want? How does it want to manage it? Below the national strategy, the primary division is between protected and open areas, the latter open to settlement, agriculture, livestock, etc. Within each of these primary land categories, utilization of wildlife resources is defined in a series of zones.

We contend that zone objectives should be specified in terms of limits to permissible change to ensure that certain specified parameters of the environment remain within specified limits. The limits may be narrow, specifying a static state; wide, permitting dynamic processes; or changing, specifying environmental trends. The essential point is that the agency commits itself to a management program that retains the state of the ecosystem within specified permissible limits. We argue that the objective for each zone should be defined in terms of four sets of factors:

a. The permissible limits to change of physical and biological resources;

b. The permissible forms and agencies of use;

c. The permissible types of infrastructure development; and

d. The permissible amounts of settlement, livestock and agriculture.

The last aspect is usually the most important and will be controlled by primary legislation; the other aspects can be regulated by subsidiary legislation as specified in the master plan.

Zoning should be based on landscape classification which provides the class of technically sound options for management of physical and biological resources.

In conclusion, we envisage the production, revision and use of master plans to be *the* primary business of conservation agencies and an inherent property of their constitution and organization. Master plans are much too important to be left to planners who provide a subsidiary technical service in the compilation of plans. The master plan represents the value system of the conservation agency and its will and capability to realize that value system.

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CHAPTER 34

CONDITIONS OF SERVICE IN A CONSERVATION AGENCY

BY

R.H.V. BELL

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1.   INTRODUCTION:

Africa contains some of the most important and spectacular wildlife resources on earth.   Between three and four percent of sub-Saharan Africa is designated as national park or equivalent reserve (Clarke 1981), while in some countries, the proportion is over 15 percent.   Important wildlife resources also exist outside protected areas.

Africa's wildlife resources are of great value in monetary and nonmonetary terms.   The nonmonetary values include the aesthetic and scientific values of conserving species, communities and landscapes, as well as the contribution of these to the quality of life and environment and to the protection of catchments, water resources and soils.   In monetary terms, the wildlife resource consists of a set of valuable commodities, which if harvested on a sustainable basis, could yield large revenues and usable products.

However, because of this very value, wildlife resources attract unauthorized and unsustainable uses. For this reason, a high proportion of the effort of Africa's conservation agencies is devoted to controlling illegal activity, of ensuring that the management and use of Africa's wildlife resources takes place according to the principles adopted by each government as giving most long-term benefits to the people as a whole.

The problem discussed in this paper is that a conflict exists between the government policies to utilize wildlife in a sustainable manner for public benefit, and the wish of certain sectors of the public to exploit wildlife for their immediate cash benefit. The field staff of conservation agencies carry the brunt of this conflict, since its members form the interface between the government and the public. This situation subjects them to strong social pressures, and frequently, to physical danger, the intensity of which is proportional to the value of the wildlife resources at stake and, hence, the urge of different parties to exploit them.

The object of this paper is to review the conditions of service of conservation agency staff in order to suggest means by which the wildlife resource may be managed in conformity with government policies and at the same time to reduce the conflict between the government and the public, and to protect conservation agency staff when conflict is inevitable.

2.   THE PROBLEM OF ATTRACTING HIGH QUALITY STAFF:

The goal of each conservation agency is to manage the wildlife resources for the benefit of the public following a policy laid down by the government.   This usually calls for both consumptive and nonconsumptive uses, for education of the public concerning wildlife resources and for research into their ecology and management.

Establishments are usually small; for example, the established staff of the Department of National Parks and Wildlife, Malawi is currently 262 of whom about 150 are active field staff, mainly wildlife scouts. Each of these 150 is, therefore, responsible for 72 square kilometers of land and wildlife resources valued at about US $120,000.

Each man is more than a simple policeman upholding the law; he is that and much else; he is a professional wildlife management officer who:

a. Wears government uniform;

b. Carries firearms;

c. Has powers of search, seizure and arrest;

d. May be required to hunt dangerous animals;

e. Conducts public relations;

f. Collects revenue;

g. Conducts or assists in research; and

h. Implements various types of wildlife management.

The problem, then, is that conservation agencies require high quality staff who are active, intelligent, highly motivated, well-trained and responsible; on the other hand, the conditions of service now widely pertaining are such that high quality recruits are not attracted to the service. Most wildlife scouts are of low rank and earn very low salaries. Their life style is hard and uncomfortable, based in isolated camps, often in poor housing, far from schools, medical facilities and even sources of food. They are generally subject to social antagonism from the public, and, finally, they are continually exposed to physical risks, from disease, wild animals, and miscreants evading arrest. Staff members are regularly killed by wild animals and in encounters with illegal hunters. Others are injured and many, with their families, suffer serious sickness.

This paper outlines a strategy for improving the conditions of service for the staff of African conservation agencies, both to attract high quality recruits, to provide for them as befits the managers of valuable resources, and ultimately to improve the management of the resource itself.

3. **THE STRATEGY**:

The strategy outlined here for improving the conditions of service for conservation agency staff consists of the following components:

a. Career structure and discipline;

b. Salary structure;

c. Operational procedures and training;

d. Manpower;

e. Living conditions;

f. Compensation;

g.   Legal aspects;

h.   Public relations; and

i.   Conservation and utilization policy.

This strategy is based on the following premises:

Each conservation agency has a range of technical objectives that require staff to work under difficult conditions and be exposed to regular risks of physical danger.

In order to carry out its tasks efficiently, the staff must be of high quality; they must be carefully selected, trained and disciplined. These measures at the same time significantly reduce the risks of physical danger by ensuring that staff have the capabilities needed to avoid or reduce risks; such control measures also reduce risks of abuse of the considerable powers entrusted to conservation-agency staff. A range of operational procedures is required to guide staff in their duties, including those involving physical risks; these need to be developed, along with the training system needed to ensure their use through the various field forces. The carrying out of these operational procedures efficiently and in safety requires certain minimum levels of manpower which are specified. In order to attract sufficient manpower of adequate quality, living conditions for agency staff must be significantly improved, in terms of the location of camps, the type of housing, the protection of camps, the availability of schooling and medical facilities, and the supply of food and other necessities. Physical injuries when they occur must be compensated; the terms of compensation legislation should be reviewed. Agency staff must be allowed to protect themselves and the legal aspects are discussed; it is suggested that commissions to assess complaints of unnecessary violence be established. The public image of each conservation agency must be improved by public relations.

To summarize, it is argued that most of the physical dangers can be avoided by high quality, trained and disciplined forces. Working and living conditions must be improved to attract and protect such high quality individuals.

Finally, the overall policies of each conservation agency must be reviewed and perhaps modified to reduce the underlying conflict of values between the agency and the public, between conservation and utilization. This is the basic cure to the problem of physical danger to agency staff. The other measures are simply palliatives treating the symptoms.

4.   CAREER STRUCTURE AND DISCIPLINE:

The premise of this component of the strategy is that, given the professional requirements, the responsibilities and the physical dangers attached to the duties of agency staff, an unusually high quality of staff is required, with a high level of training and discipline. Only such high quality staff can carry out its duties effectively in difficult conditions, avoid abuse of its powers and minimize the risks of the job. It is felt that most of the dangers in the work of agency staff are avoidable by

correct application of operational procedures by high quality staff. In the same way, casualties in the armed forces are invariably lower among high quality, well-disciplined troops.

The proposal put forward here is that the special situation of conservation agency staff requires that their recruitment, career structure and discipline should be tailored to fit their situation. It is felt that normal civil service procedures are not necessarily entirely appropriate to this situation and that a more selective system is required. A possible model is provided by typical police regulations.

Like the police, a conservation agency field force is an armed and uniformed force with powers of search, seizure and arrest. In fact, the agency field force generally works in conditions of greater independence and freedom of action than the police and, therefore, carries correspondingly greater responsibility, and is correspondingly more liable to abuse its very considerable powers.

However, in addition to its role as a law enforcement agency, the agency field force is also a scientific agency with a technical management and research role. In this situation, it is not desirable to overemphasize rigid discipline and control; rather emphasis is required on creative thinking and originality. For this reason, it is suggested that discipline and control should not be enforced with the same intensity as in the police and armed forces. The emphasis should be on selection of high quality individuals through a probationary system; systematic training in operating procedures with a system of increment stoppages, efficiency bars and examinations, and discipline through an intraministry disciplinary committee. The details are outlined below:

a.   **Enlistment:**

Original enlistment in a typical police force is for a period of four years. At the end of this period, the recruit may apply for permanent reenlistment, but may be rejected on medical grounds or on the grounds that his work was unsatisfactory. This type of regulation in effect enforces a *four-year probationary* period in which the quality of each recruit can be evaluated in depth, and unsuitable recruits weeded out. This probation system is regarded as highly desirable in ensuring the recruitment of high quality staff to conservation agency field forces.

b.   **Stoppages of Increment, Efficiency Bars and Examinations:**

Police regulations usually include a system of increment stoppages, efficiency bars and examinations by which salary increments are conditional on demonstrations of acquired skills and efficiency according to a predetermined schedule. Such a system could be developed to great advantage in the agency and should be related to the development of operational procedures and appropriate training schedules.

c.   **Discharge and Dismissal:**

Usually discharge of police officers of junior rank may be carried out by the head of department (i.e., Commissioner of Police) at any time: a)

if the officer is certified medically unfit; b) on the grounds of ineffi-
ciency; c) if within a specified number of years of his original enlistment
the commissioner considers he is unlikely to become an efficient police
officer. A police officer may, on the recommendation of his responsible
officer and the direction of the appropriate authority, be dismissed
without due notice, at any time, on the grounds of having committed an act
of misconduct. These regulations give considerably greater selective power
over staff to the head of department than normal civil service procedure
and could undoubtedly lead to more efficient and disciplined field forces.
Of course, such powers are open to abuse and their introduction to conser-
vation agencies would have to be carefully considered. It is suggested
later that a disciplinary committee consisting of agency and ministry
representatives could be established to provide an intermediate structure
between the normal civil service procedures and those of the police
regulations.

5.   SALARY STRUCTURE:

At present, the majority of wildlife scouts enter the department at
the lowest civil service rank with correspondingly low salaries. Promotion
is often extremely slow and many high quality individuals are still serving
at the starting salary after more than ten years of exemplary service and
the acquisition of a range of professional capabilities.

It must be clearly recognized that the skills and responsibilities
typically expected of a wildlife scout, including carrying firearms in
independent situations, powers of search, seizure and arrest, collection of
revenue, and a range of technical skills, would, in any other agency,
qualify the individual for considerably higher rank.

Promotion opportunities should be made available to ensure viable
career structures with opportunities for the necessary training being
provided.

6.   OPERATIONAL PROCEDURES AND TRAINING:

The duties of a conservation agency field force require a range of
professional capabilities including those of law enforcement, wildlife
management, public relations and research. Each of these capabilities
should be based on an operational procedure, that is, a predetermined way
of carrying out the operation in question. These procedures cannot, of
course, be absolutely rigid, but should take the form of recommended
guidelines to be followed when carrying out any particular task. The
procedures should be worked out by experienced staff in service, taught to
inexperienced staff in training colleges, courses and in-service training
and evaluated and updated when necessary. The efficiency of each staff
member in carrying out these procedures should be subject to assessment and
checking and related to increment stoppages and efficiency bars (see last
section).

The relevance of these operational procedures to conditions of service
and physical safety is firstly that the overall efficiency of the agency
would be substantially increased by formally instituting such a system, and
secondly, that many of the risks of physical injury would be avoided or

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reduced by the system, particularly in the areas of staff housing development, law enforcement, crop protection hunting, first aid and general hygiene.

The question of staff housing and hygiene will be covered below under living conditions. This section will cover the other points.

In developing operational procedures for law enforcement, the following areas should be covered:

a.   Standard equipment to be carried (specific to area and season);

b.   Numbers of scouts and porters per patrol, including numbers to be left at home camp and numbers to be left at temporary base;

c.   Patrol methods (see Chapter 22);

d.   Patrol reporting method (see Chapter 23);

e.   Methods of arrest of armed and unarmed groups;

f.   Training in the use of firearms;

g.   Instructions on the conditions for use of firearms;

h.   Methods of constructing searches; and

i.   Methods of processing cases.

To expand on points f and g, training and instructions on the use of firearms, these refer specifically to, firstly, training in shooting and secondly, instructions as to the circumstances in which use of firearms is permissible. The proficiency of most conservation agency staff in the use of firearms is totally inadequate. Equally, there is often confusion over the circumstances under which a wildlife scout may use his firearm to defend himself from attack. This must be clearly spelt out and all staff must be instructed and trained on the correct reaction in such circumstances, remembering that often a "split-second" decision means life or death.

Our recommendation is that wildlife scouts should be instructed to use firearms when they have reason to believe that they are in danger of death or serious injury that can be avoided in no other way, and in case of firing on humans, the aim should be to wound rather than kill. The case of warning shots needs to be worked out and the use of blank ammunition at the top of the magazine should be considered. The procedures for the use of firearms should be clearly laid down in agreement with the police and the judiciary and if necessary included in primary legislation. A procedure should be worked out for assessing cases involving death or injury of members of the public by agency staff, which would give staff the confidence to carry out their duties and defend themselves when necessary without the threat of protected legal procedures and imprisonment.

In the area of hunting of dangerous animals in pursuance of crop protection, culling, professional hunting, etc., an appropriate set of procedures should be developed, for example, covering equipment, use of firearms, hunting techniques, recording of necessary data, processing carcasses, trophies and skins, handling revenue, etc.

Many of such procedures in the various branches of conservation agencies have been worked out, in some cases, more or less informally. Our view is that a systematic effort should be made to develop all the necessary procedures, branch by branch, perhaps in the form of conservation agency handbooks, with different levels of procedure related to different grades of staff.

An equivalent effort then needs to be made in training the agency as a whole in these procedures, and a coordinated training system needs to be developed, again involving staff at all levels. This should include in-service training, agency courses on specific topics, and courses at special training facilities such as Mweka, Garoua or their local equivalents.

7. MANPOWER:

The operational procedures for effective law enforcement allow the required numbers of field staff for an area to be computed. The figure adopted in the Master Plan for National Parks and Wildlife Management for Malawi (Clarke 1983) is one game scout per 50 square kilometers. It is also accepted that the minimum patrol size that is compatible with effective action and the physical safety of the patrol itself and its base camp is three wildlife scouts and two porters with at least one porter at the home camp for its protection. It must be emphasized that the risk of assault is very dependent on the strength of the field force as perceived by miscreants and, therefore, depends on the size of the patrol on the spot and the overall size of the field force. An ideal patrol size in most areas would, therefore, be at least five wildlife scouts plus three porters, plus one wildlife scout and one porter at the home camp, so that each camp would consist of at least six wildlife scouts and four porters. In areas with serious commercial poaching by well-armed groups, considerably larger patrols may be required. They should be distributed in camps of at least the size compatible with the requirements of physical safety as indicated above, and with appropriate ratios of middle and senior level staff.

8. LIVING CONDITIONS:

The physical safety and general well-being of conservation agency staff depends not only on sheer numbers but on living conditions. It is obvious that high quality individuals will not be attracted to join an organization that does not provide acceptable living conditions for its staff.

The question of living conditions is an ever-present problem in conservation organizations. By the nature of the work, staff are frequently required to live in isolated camps far from schools, medical facilities and even sources of food, to say nothing of entertainment and recreation. The work of a wildlife scout is hard, requiring him to spend

many of his days and nights on patrol, sleeping in the open, often with inadequate tents and equipment, often at risk from wild animals and lawless men, and exposed to the antagonism and contempt of the public.

Every effort must, therefore, be made to improve the living conditions of conservation agency staff. The main points to be considered are.

    a.   The location of camps;

    b.   The type of housing;

    c.   Protection of camps;

    d.   Availability of schooling;

    e.   Availability of medical facilities; and

    f.   Supply of food.

(i)   Location of Camps:

This has been the subject of considerable debate. Briefly, there are two major options with various compromises possible. The first option is to distribute staff in a number of relatively small, relatively remote camps located in the areas to be patrolled. This is the traditional style of wildlife scout distribution and it is based on the premises that the camp itself acts as a local deterrent and that transport is not required on a regular basis to take patrols into their patrolling area. The second option is to concentrate staff in a few large camps with relatively easy access. The arguments in favor of this system are that the camps are relatively secure and easy to supply and to supervise; arguments against are that the outlying areas are completely unprotected unless an active patrol is in the area, which, in turn, depends on transport for placement; transport is in practice frequently unavailable, and, is in any case, time-consuming and expensive. The conclusion is that, if staff in both situations are equally efficient, then centralized camps afford a lower level of protection to the wildlife resource than dispersed camps.

The position adopted in the Malawi Master Plan is a compromise involving medium numbers of medium-sized camps located where possible at or near park or reserve boundaries and with reasonable road access. In areas of poorer access, i.e., Nyika, a total of 63 wildlife scouts is called for, distributed between six camps with up to 15 scouts in each. In areas of better access, i.e., Kasungu, a total of 46 wildlife scouts is called for, distributed between ten camps and between four and six scouts each.

It is desirable that radios should be installed in all camps to call for assistance in emergencies.

(ii)   The Type of Housing:

The primary limitation on housing type is availability of development funds. At present, most wildlife scouts are housed in traditional houses, many in poor condition. This, in combination with poor water supplies and

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drainage, leads to lack of hygiene and health problems. It is desirable in the long run to attempt to raise sufficient funds to construct permanent housing and to provide at least a well or borehole at each camp.

(iii)   Protection of Camps:

In many cases conservation agency staff live under constant threat of reprisals from the public. This is particularly true in housing compounds in or near cities, but it is also true in isolated bush camps, where women and children are frequently left with inadequate protection for days at a time while the scouts are on patrol. In such camps, the threat of attack by wild animals, particularly lion and elephant, is an additional problem.

Operational procedures for the protection of camps should be developed, related to specific situations. In the cities these should include security fencing and employment of security guards. In field camps, electrified fencing, now both cheap and effective, should be employed in cases of wild animal problems, and minimum staff requirements should be enforced. The use of radios should be included.

(iv)   Availability of Schooling:

This is one of the most important factors in determining the quality of living conditions as perceived by staff, and presents a continual problem in relation to isolated camps. This factor should be taken into account when siting new camps and preference given to sites within walking distance of schools. In major camps such as park headquarters, special arrangements should be made if possible to reach agreement with the education authorities for assistance with teachers. Attempts should be made to raise funds for construction of school blocks and teacher housing compatible with education authority specifications. Provision should be made for boarding facilities of children from outlying camps.

(v)   Availability of Medical Facilities:

This is another vital aspect of living conditions and one which has been equally hard to solve. Each protected area should have its own clinic and medical orderly or dresser. Each should make arrangements with the health authority to make available a mobile antenatal clinic on a regular basis. Selected staff wives should be trained as midwives and should assist with childbirths on the station when necessary. Radios in outlying camps should be used to notify of emergencies requiring assistance. Regular checks on all staff and their families should be made for certain conditions such as malnutrition, venereal diseases, malaria and sleeping sickness. First aid kits should be provided to all isolated camps and a training program in their use developed and executed. Hygiene should be considered in camp development and regular inspection and maintenance should be carried out.

(vi)   Supply of Food and Other Necessities:

The supply of food and other necessities frequently presents problems in isolated camps, even large ones. This aspect should be considered when siting and developing new camps, locating them on or near the boundaries

where possible and, through negotiation with local authorities, making available small plots of land for cultivation. In many cases, however, some form of transport arrangement is needed to provide a regular supply of food and commodities.

Attention must always be paid in arranging this to avoid regular absence of the field force from its work area, as this is invariably exploited by poachers. In existing isolated camps, a formal provision for small garden plots should be considered, especially in conjunction with electrified fencing for camp security. Similarly, trials with battery chicken facilities should be attempted, and possibly with fish production ponds.

9. COMPENSATION:

A frequent complaint from conservation agency staff is that, while they are exposed to considerable risks on a regular basis, the compensations for injury or death are inadequate.

In most countries, legislation exists that makes provision for workers in the event of injury, sickness or death. The question at issue is, are these compensation terms considered adequate for the situation of conservation agency staff?

This question is, of course, a policy matter for the government to decide. If a decision is made that a higher level of compensation is required for conservation agency staff, then various possibilities present themselves:

a. Alternative legislation could be enacted to bring into effect a higher scale of compensation;

b. A compensation fund could be established, perhaps with donations, voluntary conservation bodies or other donors, to provide additional compensation over and above that specified by legislation;

c. Agency staff could be covered by an insurance scheme taken out by the agency. Funds would have to be sought and allocated for this purpose.

10. LEGAL ASPECTS:

A significant aspect of protecting conservation agency staff from physical injury by miscreants is the legal aspect, that is, the support and protection afforded by the legal system and the judiciary. Just as special measures are taken to protect the police from injury by the public, so do the staff of a conservation agency deserve legal protection.

Firstly, as mentioned under operational procedures, there must be clearly defined regulations defining the conditions under which agency staff may protect themselves against attackers by the use of firearms.

Secondly, we propose that a commission should be established for assessing any case in which a complaint is brought against a member of the

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agency for the use of unnecessary violence. Pending the findings of the commission, the complainee should be suspended from duties but not imprisoned and the investigation should be completed within one month of the complaint being brought. The composition of the commission is an important policy consideration, but representation of the agency, its ministry, the police and the Ministry of Justice is suggested. Such a commission should be established under new primary legislation.

The commission should be empowered to present its recommendations to the public prosecutor who would be obliged to accept its recommendation unless additional evidence was available not used by the commission. In the event of the commission advising that undue violence had been used, then the agency member should be prosecuted in the normal way.

Finally, all steps should be taken to ensure maximum cooperation on the part of the police and the judiciary in the event of injury or death being caused by a member of the public to a member of the agency in the exercise of his duties. This is usually required under existing legislation, but a public relations effort is required to make sure that action is taken. The agency directorate should nominate a member of its staff to act as permanent liaison officer with the police and Ministry of Justice on cases of this kind.

11. **PUBLIC RELATIONS:**

A serious attempt should be made to improve the public image of the conservation agency and its staff. All public relations programs organized by the agency (i.e., displays, exhibitions, school visits, press and radio releases, etc.) should place emphasis on the high qualities and responsibilities of the agency's field force. The intention should be to present its members as highly professional public servants. This would assist recruitment and raise the respect in which agency staff are held by the public.

Of course, it is essential that agency staff should live up to those claims, and continuation of the training programs in public relations and conduct is necessary.

To raise morale and engender a regimental spirit in agency staff, a role of honor should be compiled of all those who have died in the course of duty. A memorial with names listed should be constructed in a prominent place.

12. **CONSERVATION AND UTILIZATION POLICY:**

So far, the measures proposed for reducing the risk and consequences of physical injury have been essentially palliatives. Ultimately, however, the solution must be to remove the source of conflict that leads to violent confrontation between members of the conservation agency and the public; it must remove the basic conflict of value system between conservation and utilization.

This is a long-term and difficult objective. It must involve a regular reassessment of value systems on which the agency's conservation

policies are based. If these policies continually give rise to violent conflicts with the public, are we sure that our policies are entirely appropriate? This question must be asked and if the answer is, no, not entirely, then the policies must be modified.

The essential requirement is to bring the department's policies of wildlife conservation and utilization into line with the public's perception of the possibilities without compromising the future of the wildlife resource. This may require modification of policies as well as modification of the public's perceptions by education and public relations.

A wide range of suggestions for utilization of wildlife resources, consumptive and nonconsumptive, have been made. It is a matter of urgency that these suggestions be followed up, tested and evaluated in order to integrate conservation and wildlife management into the development of each country, and to reduce to a minimum the conflicts of value systems leading to physical violence.

13. CONCLUSION:

The purpose of this paper is to discuss methods of improving the physical safety of the staff of African conservation agencies. At the same time these methods must maintain or improve the ability of each agency to reach its objectives.

The basic premise of the strategy described here is that the best protection for agency staff is the staff itself; that most of the risks can be avoided or reduced by high quality, trained and disciplined personnel acting according to a set of clearly defined operational procedures.

This approach requires selection of high quality individuals and systematic training. In order to attract recruits of the necessary quality, working and living conditions must be improved. The field staff must be recruited at ranks and salaries commensurate with their required capabilities and responsibilities, and they must be adequately compensated in the event of injury or death in the course of duty.

Staff must be allowed to protect themselves by the use of firearms in emergency, and the establishment of a commission to assess complaints of unnecessary violence is suggested to allow agency staff to protect themselves with confidence.

The public image of conservation agency staff must be improved by means of public relations to reduce social antagonism towards them.

Finally, the policies of conservation agencies in relation to conservation and utilization must be reviewed and if necessary modified in an effort to reduce the conflict of values between each agency and the public. This is the only ultimate cure for the problem of physical danger to staff due to illegal activity; the other methods are merely palliatives treating the symptoms.

CHAPTER 35

FUNDING AND FINANCIAL CONTROL

BY

R.H.V. BELL & J.E. CLARKE

1. INTRODUCTION:

It is a frequently stated maxim that wildlife must pay, that conservation will only be successful if it can be shown to be economically profitable. However, in most African countries, wildlife does not pay; it is a public service subsidized by the state. The exceptions are probably South Africa, Kenya, Zimbabwe and, shortly, Bophuthatswana, where revenues earned from tourism, hunting and utilization programs probably exceed the recurrent financial costs of conservation. If, then, the maxim that wildlife must pay is correct, then the prospects for wildlife in Africa are gloomy indeed.

We argue, however, that the maxim is false. It incorrectly identifies man as a producer in relation to wildlife, instead of correctly as a consumer (Bell 1983). There are certain goods that people want or require, for which they are willing to pay (as consumers); there are other goods which they do not need or of which they have a surplus for which they expect payment (as producers). In respect of wildlife, man is in the former category. It is clear, moreover, that people are prepared to pay a high price for the preservation of wildlife and wilderness areas. The price can be judged in terms of the losses that African populations are prepared to tolerate in terms of crop damage by wildlife, lost opportunity due to alienation of land, and government subventions to conservation agencies, and the amount developed nations are prepared to pay towards conservation in aid contributions and tourism costs.

We argue, moreover, that the contention that wildlife must pay is counterproductive since it renders conservation areas vulnerable to any form of land use which is more profitable (Clarke 1972). We argue that conservation is fundamentally in conflict with short-term economic interests, the dominance of which has created the need for conservation.

We would, therefore, restate the financial maxims of conservation as follows: Conservation conflicts with short-term economic interests; therefore, for conservation to succeed, people and governments must be willing to pay the necessary costs. The costs are proportional to the extent of the conflict with short-term economic interests. Therefore, conservation agencies should attempt to reconcile their objectives with those interests, and encourage the generation of revenue by any means that do not conflict with their conservation objectives. Because of the basic conflict between conservation and economic interests, funding is a perennial problem for conservation agencies.

2. WHAT LEVEL OF EXPENDITURE IS NEEDED?

The first question we need to ask is, what level of expenditure is needed to achieve conservation objectives in a particular area?

This is, of course, a hard question to answer, since it varies both according to the nature of the conservation goals and with the extent to which these conflict with the current situation. However, a basis for comparison has been provided by Cumming, Martin and Taylor (1984) as a result of a questionnaire survey carried out in 1981. Their results are

reproduced in Table 1 with some additional data for Malawi and Kenya included.

It can be seen that conservation agencies fall into three classes as follows:

a. Well-funded, with recurrent expenditure (1981 values) of over US $1,000 per square kilometer of conservation area. The only such country listed is Bophuthatswana, but the South African National Parks Board and the Natal Parks Board also fall into this category if all expenditure is included;

b. Medium-funded, with recurrent expenditure (1981 values) of between US $150 and 400 per km^2 of conservation area. The countries in this category are Zimbabwe, Uganda, Ghana and Kenya (South Africa is excluded as property belonging in category a);

c. Lightly-funded, with recurrent expenditure (1981 values) of less than US $100 per km^2 of conservation area. This class includes Botswana, CAR, Ethiopia, Mozambique, Niger, Somalia, Tanzania, Zambia and Malawi.

While these figures are not strictly comparable in all cases (particularly as to what is classed as conservation area), still one may make the rough generalization that the countries in the well- and medium-funded classes are capable of managing their conservation estate with reasonable efficiency and are able to keep illegal activity under reasonable control. By contrast, the majority of countries which fall into the lightly-funded class experience serious constraints to their management capability and are usually unable to keep illegal activity under reasonable control. (Malawi is currently an exception to this rule, but is critically stretched financially.)

We may conclude, then, with the following rough rule of thumb: conservation agencies should aim to achieve a minimum recurrent expenditure equivalent to 1981 US $200 per km^2 of conservation area. For significant development of roads, fences, accommodation and other infrastructure, considerably greater expenditure is needed.

TABLE 1

SUMMARY OF RESOURCES AVAILABLE IN 17 AFRICAN COUNTRIES MODIFIED FROM
CUMMING, MARTIN & TAYLOR, 1984

Country	Wildlife Conservation Area km^2	Total Budget US $ x 10^3	Total Manpower	Area Per Man km^2	Expenditure Per Man US $	Expenditure Per km^2 US $	Expenditure Required At US $200 Per km^2 US $ x 10^3 **
Bophuthatswana	560	3,360	226	2.4	14,867	6,000	3,360
Botswana	103,953	1,082	180	577.5	6,011	10	20,791
Central African Republic	57,000	460	173	329.5	2,659	8	11,400
Ethiopia	23,000	1,345	298	77.2	4,513	57	4,600
Ghana	10,161	2,409	1,169	8.7	2,061	237	2,409
Kenya	40,000	7,500	2,000	20.0	3,750	188	8,000
Malawi	11,000	500	240	45.8	2,083	45	2,200
Mozambique	32,250	600	321	100.4	1,869	19	6,450
Niger	4,386	24	15	292.4	1,600	5	877
Nigeria	17,564	?	?	?	?	?	3,513
Rwanda	2,740	?	176	21.7	?	?	548
Somalia	3,340	167	227	14.7	735	50	668
South Africa*	19,565	4,024	477	41.0	8,436	200	4,024
Tanzania	257,400	5,140	942	273.2	5,456	20	51,480
Uganda	7,607	2,719	1,054	7.2	2,580	357	1,521
Zambia	223,270	2,440	745	299.7	3,275	11	44,654
Zimbabwe	47,000	13,000	2,147	21.9	6,055	277	13,000
Total (Mean) (LESS BOPHUTHATSWANA)	860,796 860,236	44,770 41,410	10,340 10,114	83.2 85.1	4,330 4,094	52 48	172,159 172,047

Note: * Data are for Kruger National Park and Addo National Park only and does not include tourist, mechanical, and construction budgets or staff.

**Where current expenditure already exceeds US $200/km^2, the existing figure is retained.

Table 1 indicates that the total recurrent expenditure on conservation for the 17 countries listed is about 45 million dollars per annum. However, there are important omissions from the table. Huntley (pers. comm.) has estimated that the total expenditure on conservation in South Africa in 1983 was about 80 million US dollars. The table also contains no data from a number of other important conservation agencies including Namibia, Zaire, Gabon, Congo, Cameroon, Senegal and Sudan, among others. We would probably not be too far wrong if we estimated that the total recurrent expenditure on conservation in Africa in 1981 was around 150 million US dollars, of which about half (75 million) was in South Africa, and a similar amount in the other countries.

We have included in Table 1 a column to show the required expenditure if each agency's expenditure were brought up to US \$200/km^2 (leaving those above this figure as they are). The total for the 15 countries (leaving aside South Africa and Bophuthatswana) is about 165 million dollars, that is, nearly four times the actual current expenditure. A proportional increase for the countries not listed would give an estimated required expenditure of about 300 million dollars for Africa without South Africa.

A similar result is obtained from the estimate of Clarke (1981) that about 4% of sub-Saharan Africa is designated as national park or equivalent reserve. The subcontinent totals about 21.2 million km^2 without South Africa and 22.4 million km^2 with it. Four percent of these figures is 848,000 and 896,000 km^2 respectively, giving, at US \$200/km^2, US \$170 million and US \$18 million respectively (although the actual expenditure in South Africa would bring the total up to US \$250 million). These figures are in reasonable agreement with the estimate in the last paragraph, taking into account the large areas of conservation area in many countries not classified as national parks or equivalent reserves.

3. STAFF DENSITIES:

Table 1 also gives an indication of staff densities available to various conservation agencies. Here, again, there is a great deal of variation, with the well- and medium-funded agencies tending to have densities about one staff member to 20 km^2 of conservation area and the lightly-funded agencies tending to have staff densities below 1:50 km^2. (Again, the South Africa figure is misleading since a high proportion of staff has been omitted.)

Cumming, Martin and Taylor (1984) note that IUCN recommends a staff density of 1:50 km^2. However, we feel that this density is usually too low for effective management if all types of staff are included. We recommend (see Clarke 1983 and Chapter 22) an effective law enforcement staff density of 1:50 km^2 as a minimum requirement for areas containing elephants and a still higher density (i.e., 1:20 km^2) for areas containing high priority species such as rhinos and gorillas. These are wildlife scouts alone, and we recommend the following minimum ratios of other staff to one wildlife scout:

Senior staff (management)	0.04 (1/25)
Middle level staff (management)	0.10 (1/10)
Administrative and technical staff	0.05 (1/20)
Research staff	0.05 (1/20)
Nonestablished staff (i.e., porters)	0.33 (1/3)

Thus, for each wildlife scout, we recommend at least 0.53 other staff, giving at one wildlife scout /50 km^2, a total staff density of one per 33 km^2. We, therefore, recommend that conservation agencies should aim for an effective staff density of at least 1:30 km^2 (not including tourist staff). If the agency is responsible for areas of high conservation priority and high levels of man-animal conflict, the density should be considerably higher, i.e., 1:10 km^2.

4. EXPENDITURE PER STAFF MEMBER:

A point of great importance commonly overlooked is the expenditure required per staff member to render each one effective. This can be expressed either in terms of the expenditure per man, as in Cumming, Martin and Taylor (1984) and Parker (1984), or in terms of the ratio of salaries to total expenditure as in Clarke (1983).

The recalculated mean for expenditure per man in Table 1 is US $4,330, although without the Bophuthatswana figure it becomes US $4,094. It should be noticed that at the recommended expenditure of US $200 per km^2 and staff density of 1:30 km^2, the expenditure per man should be US $6,000 per man. These are total recurrent costs and should not be confused with the figure of US $8,000 per man quoted by Parker (1984), which is the estimated capital cost of placing a man in the field, including costs of housing, equipment and training.

It is clear, therefore, that in the majority of agencies, the expenditure per man is well below the optimum level. This means in practice that such agencies consist primarily of wildlife scouts in the field without adequate logistical support. This point emerges from an analysis of the proportion of salaries to other expenditures. Normal management procedure recommends that not more than 30% of total recurrent expenditure should consist of staff salaries, while 70% should consist of backup (particularly transport) equipment and other facilities. Clarke (1983) shows that in Malawi in 1983, 50% of total recurrent expenditure was due to staff salaries and the proportion has continued to rise. This is a common tendency since establishments are fixed and salaries are indexed to inflation, while total allocations tend to remain constant. Since transport costs also tend to rise continuously and are largely unavoidable, there is a general tendency for expenditure to become partitioned between salaries and transport, a situation that leads to relatively inefficient use of available resources. We recommend that ideally, recurrent expenditures should be divided more or less equally between salaries, transport and other expenditure.

Finally, it is important to emphasize that the quality of staff is at least as important as quantity or as the expenditure per man (see also Chapter 36). High quality staff can perform effectively on very limited resources, but low quality staff cannot achieve much, however well-equipped they are. The importance of training can hardly be overemphasized.

5.   SOURCES OF FUNDS:

When considering sources of funds for conservation agencies, it is important to distinguish between funds allocated to the agency and revenue generated by the agency. This is because, in most cases, revenue generated is directed to central governments so that funds allocated are not directly related to revenue earned.

There are two main sources of funds allocated to African conservation agencies. These are national government allocations and donations from other bodies. The point we wish to emphasize here is that by far the most important source is national government allocations. Unfortunately, detailed figures are not available, but we estimate that at least 75% (perhaps considerably more) of all funds allocated to conservation in Africa is derived from national governments with the balance being contributed by external donors. Under national government allocations, we include aid contributions channelled through normal treasury channels.

We feel that this is an important point to be aware of because it places the much publicized efforts of the Western conservation establishment in their proper perspective and emphasizes that conservation in Africa depends very largely on the support of national governments and, hence, on the consent of local populations and the state of national economies.

The following points concerning the soliciting of funds from donors should be noted: it is very often difficult to reconcile the development of a comprehensive coordinated conservation strategy and master plan with reliance on funding from external donors. This is because most donor agencies have specific requirements as to the type and amount of assistance they give and they tend to prefer discrete tangible projects rather than general contributions to ongoing programs. Thus, while donor funding may play a vital role in overcoming particular bottlenecks and initiating programs, the overall strategy must be to reduce reliance on donors.

Of course, funding from government allocations is not always predictable either. These uncertainties in funding from both government and donor sources impose certain characteristics on the planning process. It is necessary to plan programs on a modular basis so that certain tangible objectives can be reached with each guaranteed funding package, and so that developments have a good probability of completion with committed funds. For example, a recent master plan for the development of the Wildlife Research Unit in Malawi was based on a series of modules, a headquarters unit, a laboratory unit and a series of field units. These modules need to be added in a certain order to produce a continuously functioning whole. Thus, phase one consists of sequential development of the high priority field units which can function independently; phase two consists of development of the headquarters and service units which coordinate and upgrade the capabilities of the existing field units; phase three consists

of completion of the lower priority field units. Development funding may terminate at any point without impairing the status of the already existing units.

In soliciting donor funding, there are certain tendencies that must be resisted. The first is to develop facilities that cannot be maintained once donor funding is terminated. There have been too many examples of this kind in African conservation to require detailing. Thus, a primary consideration in any project submission should be the long-term future of the program.

A second tendency to be resisted is that of modifying goals and policies to attract funding. Familiar cases are those where protected area zoning, i.e., of wilderness zones, has been modified to accommodate investment interests in tourist developments. It is to ensure that such decisions are subject to informed scrutiny and are in the best interests of the agency as a whole that emphasis has been placed in Chapter 35 on the constitutional aspects of master planning.

We conclude, then, that the most important source of conservation funding is national government allocation. This is desirable since it allows long-term planning and coordinated development and maintenance of conservation programs as well as direct government participation in and control of the management of each country's wildlife resources. It also emphasizes the importance of public commitment to conservation, and, hence, of public relations and the overall health of the national economy.

6.   **GENERATION OF REVENUE:**

In discussing this topic, a key question is: to whom does revenue accrue?   Alternatives include the central government, the conservation agency, local authorities, the private sector and local individuals.   A related question is, what function does revenue generation serve; contributing to the national exchequer, improving the attitude of the central government towards conservation, covering conservation agency costs, stimulating the private sector, improving the rural economy or improving public attitudes towards conservation?   In each case, the relative contribution of foreign exchange must be considered.

The answers to these questions are determined both by technical considerations, including the productivity and accessibility of the areas concerned, and most importantly, by policy decisions. These decisions cannot be reached as a result of economic analyses; in fact, they determine the outcome of such analyses. However, policy decisions may subsequently be modified as a result of feedback from analyses. This is to say that economic analyses are one set of factors contributing input to these policy decisions, but they are not the only set and often not the most important. Other factors are socio-political considerations and aesthetic considerations related to conservation area goals.

Within this framework, the decisions can be made as to the type and amount of utilization to be permitted in each zone controlled by the conservation agency. The alternatives have been discussed in Section 3 of this volume, and may briefly be summarized as follows:

Tourism and nonconsumptive recreation;

Sport, hunting and fishing;

Culling for ecological reasons;

Cropping for economic reasons; and

The use of other products, i.e., timber, honey, found ivory, etc.

In each case, it is necessary to specify the agency by which the utilization will be carried out, i.e., the conservation agency itself, other branches of government or the private sector, and if the latter, which part of it.

It should be noticed that most forms of wildlife utilization are in direct competition with illegal utilization, so that in order to generate revenue, conservation agencies need to allocate expenditure to law enforcement and public relations. If these costs are included in the balance sheet, the economic viability of utilization scheme is usually less positive. This is paradoxical since a primary objective of revenue generation is to put the conservation agency in a position to reduce illegal utilization by means of law enforcement and public relations. We, therefore, advocate a more direct approach of attempting to integrate local utilization legally into the management plan where possible so that the benefits accrue directly to the chosen target populations, rather than through the indirect loop of utilization scheme-revenue generation-reallocation by government assistance to local populations plus law enforcement. Suggestions for local participation are put forward in Chapter 20 and 21.

A final point to emphasize is that in most conservation areas, generation of revenue is not the primary objective, but is subsidiary to other objectives such as preservation within stated permissible limits of various biotic communities and aspects of landscape aesthetics. Revenue may be generated only, insofar as to do so does not prejudice the primary objectives. The extent to which environmental modifications are permitted in the interests of utilization and revenue generation depends on the value system of the conservation agency for the area in question, and must be specified clearly and quantitatively in the master plan for each zone.

7.   CONTROL OF EXPENDITURE:

Control of expenditure is the primary means of control of the activities of an organization. The point we wish to emphasize here is that expenditure control must be treated as an integral part of the overall planning and control structure as outlined in Chapter 32. This structure includes the following components:

Government policy;

Legislation;

The master plan (including management and development plan);

Estimates;

Project submissions;

Allocation of funds;

Grants;

Work programs; and

Progress reports.

Each level of expenditure should be seen as a component of the overall integrated control system, which is structured as a negative feedback system that can embody the concept of adaptive management.

8. CONCLUSION:

Conservation agencies have certain primary objectives which are characteristically at variance with short-term economic interests. Conservation must, therefore, be expected to cost money, both to governments and the private sector. It is a mistake to attempt to justify conservation on economic grounds, firstly, because economic prof ibility is often impracticable without seriously compromising conservai on objectives, and secondly, because such a justification renders conservation vulnerable to any more profitable form of land use that may be found. Economic justifications may be politically expedient in the short-term, but in the long-term they are likely to be counterproductive.

Revenue generation may be encouraged, insofar as it does not conflict with primary objectives of conservation of biotic communities, landscape aesthetics, etc. The extent of permissible environmental modification in the interests of revenue generation must be spelt out in detail in the master plan for each zone. Decisions are also required on the type of utilization, the amount of utilization, the agency conducting the utilization, the sectors to which revenue should accrue and the level of infrastructure development. Cumming, Martin and Taylor (1984) have concluded that those countries that earn significant revenue from wildlife utilization show a more favorable attitude towards allocation of government funds to conservation.

We estimate, on the basis of data provided by Cumming, Martin and Taylor (1984), that the total recurrent expenditure on conservation in Africa is in the region of US \$75 million per year (in 1981 US \$). Of this amount, the great majority is derived from allocations by national governments, the minority from external donations. We feel that this is a desirable balance since the management of natural resources must be the responsibility of national governments rather than external bodies. It

emphasizes the point that the future of conservation in Africa depends on the consent of national populations and governments, and on the economic health of those countries.

We agree, however, with Cumming, *et al*. (1984) and Parker (1984), that most conservation agencies in Africa are seriously underfunded and under-staffed. We suggest that a figure to aim for in funding density is US $200 per km^2 of conservation area (in 1981 dollars). This would give a requirement for around US $180 million per year for the national parks and equivalent reserves, and a further US $120 million for lower status areas, giving a total annual recurrent requirement of about US $300 million. In our opinion, this is a relatively modest requirement for the management of what is arguably the most important terrestrial wildlife resource on earth, and which, given reasonable objectives and sound management, could probably cover most of its own costs.

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SECTION 6

COUNTRY REPORTS

CHAPTER 36

<u>MOROCCO</u>

<u>PEACE CORPS MOROCCO WILDLIFE/PARKS PROJECTS</u>

BY

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Morocco's natural resources have been deteriorating for centuries as a result of extensive population growth, agricultural expansion and an increase in drought conditions and desertification. What was once forest land has now become poor range land, and what was once good range land has now become desert. The only natural areas are those which are extremely isolated by rough mountainous terrain or protected by the government. Land use pressure has been so great in some areas that it has become necessary to fence the reserves.

At one time, wildlife resources were abundant in Morocco. By the time of the Roman occupation, around the fourth century, all of Morocco's elephants had disappeared. Shortly after that, the crocodiles followed. Then in more recent times, in the 1920s the ostrich and lions disappeared.

The service of The Protection of Nature, under the administration of the Department of Waters and Forests, has the responsibility of managing Morocco's parks and reserves. Recently, the Director of Waters and Forests requested technical assistance from the Peace Corps. On February 15, 1985, a group of five Volunteers began their service working on four of Morocco's top priority projects, the National Park at Massa, Mt. Toubkal National Park, the Gazelle Reserve at Sidi Chiker and a Wetlands Management Area at Moulay Bousselham.

The top priority project is the national park at Massa. This park has received special attention from the IUCN in the form of grants to purchase equipment such as a Land Rover, two-way radios, motorcycles and other minor items. The park is primarily a coastal area, approximately 60 kilometers long, located just south of the City of Agadir. It is characterized by outstanding features such as white dunes, euphorbe vegetation zones, a forest stand and two major estuaries. It is one of the few areas where the bald ibis (*Geronticus eremita*) can be found in the wild.

The proposed area of the park is 76,000 hectares, however, there are about 10,000 people living within its boundaries. At present, only 12,000 hectares are being managed by the Department of Waters and Forests.

Traditionally, the region of Massa is the home of the Souss Berber tribe. However, the lands in and around the park have been used for centuries by Arab nomads coming north from the Sahara for summer grazing. In recent times, the sedentary local tribes have expanded their agricultural activities to such an extent that fences and roads now block the ancient routes of migration. Now one finds tiny pockets of permanent Arab settlements in the region and many of these are located within the boundaries of the proposed park. This increased population pressure is exerted very heavily upon the park since it was once land owned by the government and freely available to all users. Extensive plowing of marginal land (250 mm rainfall) and heavy grazing by goats and sheep have accelerated the deterioration of the environment.

The major attraction, in terms of fauna, are the birds. The two estuaries are important breeding and wintering grounds for flamingos, herons, spoonbills, ducks, grebes and other shorebirds. The ibis, cormorants, gulls and falcons primarily use the cliffs overlooking the sea. Bustards, partridge and sand grouse may also be found in the desertic

steppe areas of the park. Mammals at Massa include fox, jackal, mongoose, wildcat, bushpig and Cuvier's gazelle.

The Peace Corps Volunteer and the Waters and Forests staff are engaged in the following research projects at Massa:

a. Hydrological studies of the effects of ground and surface water on the park environment;

b. Reintroduction studies for Cuvier's and Dorcas gazelles;

c. Waterfowl habitat studies; and

d. Management and planning of tourism.

The Gazelle Reserve of Sidi Chiker was created in 1952 by the Department of Waters and Forests as a part of their sylvo-pastoral management program. It is located on the semiarid plains of the province of Safi between the cities of Chemaia and Chichaoua. The local forest service in charge of managing the reserve has an office in the town of Sidi Chiker, 22 kilometers to the west. A forestry engineer stationed there visits the reserve once or twice a week. On the reserve itself, there are three game scouts or guardians.

The 2,000 hectare reserve is completely enclosed by a barbed wire fence which totals approximately 27 kilometers in length. It is well-known that the gazelles are frequently found outside of the fence and jackals and other predators can pass freely in and out as well. The function of the enclosure is actually to protect the grassland habitat from use by local sheep herders. There is a vivid contrast between the quality of the range land on the outside of the fence as compared to that within.

The Moroccan Forest Service estimates that there are between 200 and 250 Dorcas gazelles on the reserve. According to a study done by a Peace Corps Volunteer in 1974, at that time, there were between 80 and 100 gazelles and certain IUCN experts tend to believe that these numbers are still accurate.

Some of the problems concerning the management of the reserve exist because it is located in a very isolated rural area at a great distance from the regional forest service headquarters and requires a great deal of expense in gasoline and time to get there. Poaching is also a problem. A visit to the market in Marrakech shows that gazelle heads and skins have a mystical value prized by sorcerers and occult groups.

The overall health of the animals is said to be good, however, a small fawning percentage is reported. It is likely that, in addition to the wild predators, dogs may also be taking their toll. Also, if the forest service estimate is correct, one gazelle per 10 hectares represents an extremely high density for an animal in this type of environment, therefore, intra-specific behavioral factors can be playing a role as well.

This reserve will function as a source of gazelles for reintroduction to the park at Massa.

Located in the southern portion of the province of Marrakech, Mt. Toubkal, the highest peak in North Africa is found in the middle of the national park. The park is characterized by rocky soils, snowcapped peaks, and alpine pastures with shrubs and some trees. In the lower elevation zones, the Department of Waters and Forests has maintained a forest reserve which is the home of the mouflon or barbary sheep. When comparing the vegetation in the reserve to the adjacent lands, one can plainly see the effects of overgrazing by the local herds of goats and sheep.

Within the reserve, the dominant tree is the green oak which is heavily browsed by the mouflon. According to the local forest service, there are between 200 and 300 mouflon in the reserve. Upon close examination of the vegetation in the reserve, it is evident that the present size of the herd of mouflon is in excess of what the forest's natural capacity can support. There is not only evidence of overbrowsing within the reserve, there is also a great deal of crop damage in the agricultural lands nearby.

The forest service has been considering several possibilities for management of the land and the animals. One idea is that they can enlarge the reserve by the acquisition of adjacent communal pasture land to accommodate the animals, but this would take away grazing land from the local community and put even more pressure on their remaining communal lands. In a project such as this, the only way it could be accomplished would be to provide some type of compensation for the land. Another alternative might be to open a strictly controlled hunt whereby the proceeds from permit sales would go directly back to the people who relinquished their grazing rights.

The Volunteer and Waters and Forests staff are seriously engaged in an agropastoral study to find out how the possible management plans would affect the quality of the pasturage and also take into account crop damage issues. If the possibility of acquiring new lands becomes impossible, then one must consider reducing the number of animals as it exists today. This could be accomplished in one of two ways. The animals could be trapped and transferred to other areas of Morocco if a proper habitat could be found, but this is not very likely due to the lack of sufficient water sources and available mountain reserves. The other possibility is to conduct a controlled hunt to maintain the number of animals at an optimum level.

Located within a two-hour drive of the nation's capital, the Wetlands Management Area of Moulay Bousselham, also known as Merja Zerga, is Morocco's largest waterfowl refuge. The area, which is a large estuary, covers over 7,000 hectares.

Problems facing the management of the area are numerous, the most serious of which are grazing cattle in protected areas, illegal fishing and poaching. The shallow brackish water of the lagoon is an attraction for several species of waterfowl such as flamingos, herons and ducks. During the winter months, thousands of ducks literally pour into this area from the western coast of Europe which is only about 200 kilometers away.

The Volunteer and Waters and Forests personnel are studying the population distribution of waterfowl, migration patterns, water quality and

feeding habits. Finally, in this area as well as the others, a prime job of each Volunteer is to encourage the development of management objectives and strategies so that they can be followed in the future regardless of any change of personnel.

CHAPTER 37

LIBERIA

PEACE CORPS LIBERIA

WILDLIFE/PARKS PROJECTS

BY

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Map showing the Republic of Liberia with surrounding countries Sierra Leone, Guinea, and Ivory Coast, the Atlantic Ocean, major rivers, towns, and numbered national parks and nature reserves including LOFA MANO N.P., CAPE MOUNT FOREST N.R., WONEGEZI MOUNTAIN RANGE N.R., MT. NIMBA N.R., CESTOS-SENKWEN N.P., SAPPO N.P., and CAVALLY FOREST N.R.
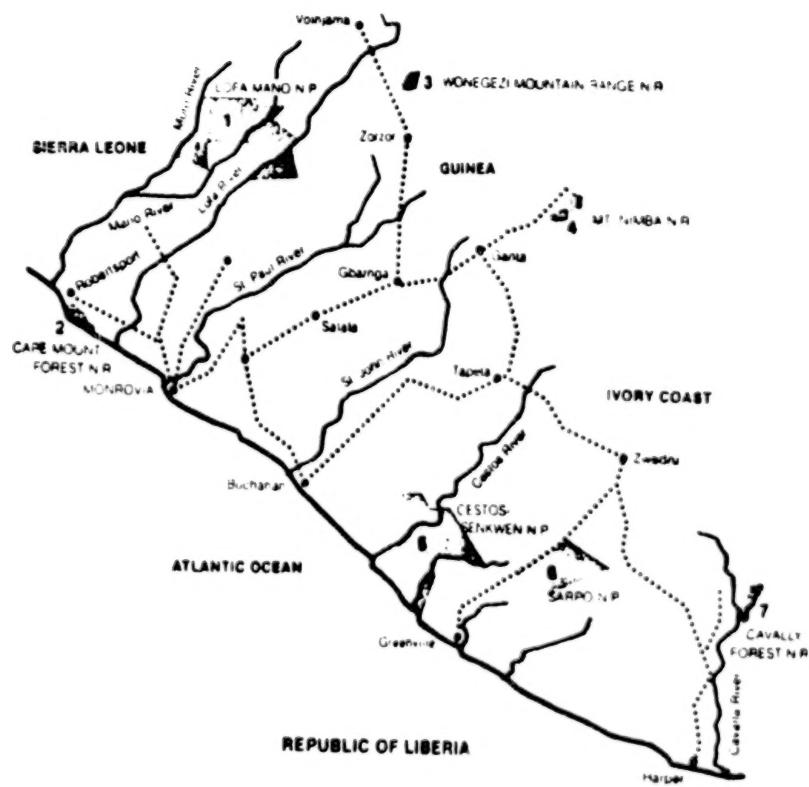
1.   OVERVIEW OF LIBERIA:

a.   Historical Facts:

Liberia, the oldest independent country on the African Continent was founded in 1822 by free blacks from the United States of America. It declared independence on July 26, 1847. From 1847 to April 12, 1980, it was ruled predominantly by the Afro-American settlers. In 1980, a military coup ushered in a military government. The country is presently in a transitional stage in an attempt to return it to civilian constitutional rule by 1986.

b.   Geography:

Geographically, the country lies on the southwestern bulge of West Africa. It has an area of 43,580 square miles. It is bordered on the east by the Republic of Ivory Coast, on the west by the Republic of Sierra Leone, on the north by the Republic of Guinea and on the south by the Atlantic Ocean. The population is about 2.6 million (May 1984 Census) with an annual growth rate approaching 3%.

c.   Geology:

The geology of Liberia is made of the Liberian Age Province, Eburnean Age Province and a Pan African Age Province. Rocks of the Liberian Age group extend into neighboring Sierra Leone, Guinea and Ivory Coast, and predominately are highly foliated granitic gneisses. Within the Liberian Age Province are metasedimentary rocks such as quartzites, amphibolites, pelitic schists and bonded ironstones. Rocks of the Eburnean Age are restricted to southern Liberia where they extend into the Ivory Coast. Generally, Eburnean rocks are more biotite and rich than the Liberian Age granitic gneisses. Rocks of the Pan African Age are found along the coast northwest of Greenville in the southeast to Sierra Leone. Rocks in the province range from basic igneous to pelitic rocks metamorphosed to the granulite and amphibolite grades. Also found present are post Precambrian rocks, which are unmetamorphosed sedimentary rocks outcropped principally along the low-lying coastal area between Monrovia and Buchanan.

Liberia has a significant deposit of mineral resources. The economic usefulness of the mineral deposit within the various rock formations is of tremendous importance for development purposes. For over twenty years or more, Liberia's mineral deposit has been of dominating importance and iron ore is the country's principal export earner. Other mineral deposits found in Liberia include diamonds, gold, barite, kyarite, manganese, rulite, silica sand, bauxite and clay.

d.   Landforms and Soils:

Four physiographic zones can be distinguished in Liberia: coastal plains, rolling hills, plateaus and mountain ranges and northern highlands. The coastal plain zone is characterized by a relatively straight coastline with sand bars and long beaches, salt, freshwater lagoons and a few promontories like Cape Mount near Robertsport, Cape Mesurado in Monrovia and Cape Palmas in Harper. The belt of rolling hills parallel to the

coastal zone has elevation in the order of 300 feet (90 m.) There are numerous hills, valleys and water courses in this zone. The plateau and mountain ranges are behind the rolling hills. Table lands reach heights of up to 1,000 feet (300 m.) and mountain ranges are found up to 2,000 feet (600 m.) The northern highland zone is situated in Upper Lofa and Nimba counties and is comprised of the Wologisi Range with a height of 4,450 feet (1,350 m.), and the Nimba Range with an elevation on the Liberian side of 4,540 feet (1,385 m.). Both mountains contain iron ore deposits of which the Nimba Range is being exploited.

e. Soil Resources:

Soils in Liberia as classified by USDA classification are predominately of the Ultisols order, and also include the Entisols and Inceptisols. The soils can be divided by physiography into upland soils and lowland soils. The upland soils generally have a surface horizon from 20-30 cm. thick, which may be gravelly. The underlying horizon is typically very gravelly and usually exceeds 1.5 m. in thickness. The gravel black ironstone concretions grade into plinthite at depth. The high gravel contents restrict root growth and have a low available water holding capacity (AWHC). The erosion hazard is moderate to severe on these soils which occupy hill slopes and crests.

The lowland soils are found in swampy bottom lands, flood plains, stream terraces and foot slopes. They have plane or concave surfaces and slopes do not exceed 3%. Textures range from sandy clay or sandy loamy fine sand and there is characteristically no gravel. The sandier soils exhibit high permeability, low AWHC and low nutrient availability.

Most of the lowland soils exhibit moderate permeability, medium-to-high AWHC and medium-to-high nutrient availability. They are well-suited to vegetable production, especially if situated on low stream terraces. They may require drainage and be susceptible to flooding if situated in swamps and flood plains.

The soils are acid, pH 4.5 to 5.5 and have low base saturation, 10 to 40%. Hydrogen and aluminum cations (H^+ and Al^{+3}) have replaced most of the bases. The low pH would tend to reduce nutrient availability and could cause iron and aluminum toxicity. Iron toxicity is known to occur in rice. Phosphorous is almost always deficient, except perhaps right after burning of slash after 10^+ years of fallow. Nitrogen is commonly deficient, although less so in the valley swamps. Cation exchange capacity (CEC) of the soils is low, being highest in the lowlands where humus contents are high enough to bring the CEC up to 8 to 14 meq./100 g. In the uplands, cultivation causes oxidation of the humus but in the lowlands with good management, the humus levels can be maintained mostly due to the higher moisture level. If organic matter levels are maintained by good management, then the limiting nutrient will probably be phosphorous followed by nitrogen.

f. Climatic Conditions:

The climate of Liberia is determined by the country's geographic position near the equator and the Atlantic Ocean. Temperature is even and

warm throughout the year with extremely high humidity. The seasons are marked by variations in precipitation and not by changing temperature. The seasons are referred to as "rainy season" and "dry season." The rainy season starts from April to October and is caused by the South Atlantic subtropical high called the southwest monsoon.

Precipitation in Liberia is heavier than for most other parts of West Africa. This is caused by the run of the coastline from northwest to southeast which forms a right angle to the prevailing southwesterly winds which bears the rain. On the average, Liberia receives nearly 160 inches (2,000 m.) of rain per year.

g. Economy:

The Liberian economy is dominated by the production of iron ore and rubber for export, mainly by foreign-owned enterprises. The export industry enclaves are the main sources of earnings and wage employment, and contribute a sizeable share of government revenue. The export sector can be called the monetary sector of the economy. Traditional agriculture, on the other hand, has minimal interaction with the monetary economy, but supports about 70% of the population at very low levels of productivity and income. The main products of traditional agriculture are rice, cassava, palm products and sugarcane.

The forestry sector contributes about 8-10% of the GDP. From 1973-1977, the contribution of this sector rose from 2.4% to 3.8% of GDP. The export earnings are received from few goods. In 1978, forest products held the third position after iron ore and rubber.

2. HISTORY OF CONSERVATION:

The foundation for conservation and development of forestry and forest industry in Liberia is the "Act for the Conservation of Forests in the Republic of Liberia" of 1953. This resulted in the creation of the then "Bureau of Forestry and Wildlife Conservation" under the Ministry of Agriculture.

The forest policy principles emphasize:

a. Maximum utilization of the forest resources;

b. Increase in added value achieved by further processing of round wood; and

c. Guarantee of sustained field through such measures as refor-estation.

The legislation sought to clarify the status and ownership of all forest areas, i.e., areas which produce timber and which fall under the jurisdiction of the law. The establishment of forest reserves, national forests, succeeded in placing the majority of the closed high forests under legal protection. As a result, ten forest reserves, totalling about 15,663 km^2, more than 16% of the country's land area were set aside as national forests.

a.   Wildlife Conservation:

Prior to the events that culminated into the then Bureau of Forestry and Wildlife Conservation becoming a public corporation by an Act of Legislature in November, 1976, there were numerous attempts by a few individuals to initiate a viable wildlife conservation program in Liberia. A prominent figure among these individuals is Dr. Kai Gurry-Lindahl. His reports entitled, *Report to the Government of the Republic of Liberia on Conservation, Management and Utilization of Wildlife Resources (1969)* and *A Conservation Plan for Liberia With Special Emphasis on Wildlife Resources and the Nimba Area (1973-1977)*, summarize the approach to a comprehensive wildlife conservation plan for Liberia. His efforts were then complemented by the establishment of a Wildlife Section in the Forestry Development Authority (FDA).

The Wildlife Section with a small staff embarked on an intensive training program that resulted into nine trained personnel at various levels, three of which have since left the Forestry Development Authority for various reasons. The training paid off with the initiation of a nationwide wildlife conservation education and awareness program. This program stimulated the organization of the Wildlife Society of Liberia. Other immediate preoccupation of the wildlife regulations is the establishment of protected areas and an extended public relations campaign.

Through the years 1977 to 1983, the success of the Wildlife Section was minimal although tremendous efforts were made to establish a viable wildlife conservation program with a system of protected areas throughout the country.

As a result of an ecological survey conducted in late 1978 and early 1979 under the sponsorship of the IUCN and WWF, seven forest areas were selected to be set aside for national parks and nature reserves; a portion of the Sapo National Forest was among selected areas. Other areas included in the study were: Cape Mount Forest, Lofa-Mano National Forest, Mount Nimba Forest, Cavalla Forest and the Wonegezi Mountain Range.

b.   Liberia's Conservation Areas:

Liberia occupies part of the Guinea Forest Block and in its climax vegetational state would be covered with lowland tropical rain forest.

Liberia, however, is not entirely homogeneous. With this in mind, Liberia's conservation areas were surveyed to include large tracts of this unique ecosystem and biographical features. At the same time, every attempt was made to prevent human conflict within conservation zones. Therefore, many of Liberia's existing and potential conservation areas were chosen not only for some important faunal, floral or geological feature, but because of the low population and few valuable timber and mineral resources existing inside the park.

The following lists Liberia's proposed national parks and nature reserves, including some of the features that lend them their unique value.

(i)   Wonegezi Mountain Range:

This area contains some of the highest elevations in Liberia. Here can be found the only remaining area in Liberia with an intact example of a transitional vegetative type between lowland and montane rain forest.

(ii)   Cape Mount (Nature Reserve):

This nature reserve contains Liberia's only rocky shoreline. A coastal forest which holds high tourist value.

(iii)   Mount Nimba (Nature Reserve):

Although already substantially degraded by logging concessions and mining encroachment, this forest is Liberia's highest and merits strict protection.

(iv)   Cavalla Forest (Nature Reserve):

Containing prime lowland tropical rain forest and abundant representative wildlife, this area on the border with Ivory Coast is destined for timber exploration if not officially proclaimed.

(v)   Lofa-Mano National Park:

This park (not officially proclaimed at this time) may contain 1/3 of Liberia's elephants and pristine riverine habitat. This, the largest of Liberia's proposed national parks, is quickly losing its boundary lines to shifting subsistence farmers.

(vi)   Cestos-Senkwen National Park:

This proposed park contains a good representation of Liberia's native fauna and flora, has a major river running through it (Cestos), and endangered littoral forest including an important mangrove ecosystem.

(vii)   Sapo National Park:

Now officially proclaimed, this park still lacks the necessary policing force to enforce its boundaries. The area includes almost entirely primary evergreen forest, abundant wildlife and plant species, and is easily accessible along the Sinoe River.

c.   Common Tree and Large Mammal Species of Liberia:

Common tree species in Liberia are many. Some of the more prominent species include *Terabilinia spp*, *Parkia bicolor*, *Parinaria spp*, *Sacoglotus gabonensis*, *Pentadesma spp*, *Piptadeniastrum Africanum*, *Lophiraalata*, *Terminapia spp* and *Wapaca spp*, all conspicuous trees of the forest canopy. Secondary forest species found typically in Liberia include *Musanga cecropioides*, *Anthocleista nobilis* or *Parviflora* and *Fagara macrophylls*. Secondary forest makes up to 30% of Liberia's forest cover.

Wildlife species worthy of mention are primates (over eight species in Liberia including the chimpanzee), forest elephant (*Loxodonta cyclotis*), leopard (*Panthera pardus*), pygmy hippopotamus (*Choeropsis liberiensis*), bongo antelope (*Tragelaphus euryceros*) and Jentink's duiker (*Cepholophus jentinki*). Avian species are especially numerous in Liberia with over 500 recorded birds. Liberia contains a good representation from the reptilian class with three types of crocodiles, Nile monitor lizard and abundant snake life; most notably the gaboon viper, boomslang, green mamba and forest cobra.

d.   Population Status of Liberia Key Wildlife Species:

Little research has been done in inventorying mammalian species in Liberia. Therefore, not much is known of their relative population status.

Elephants, estimated at 500 animals in 1980, probably exist well below that number now. Their habitat is being quickly reduced and isolated and poaching is a severe problem. Chimpanzee (*Pantroglodytes*), shot as agricultural pests, and taken alive for experimentation, pets and export, are openly persecuted. The unique pygmy hippopotamus (found only in Liberia, Guinea and Sierra Leone) is apparent in Liberia's rivers, but hunted relentlessly.

A bright spot in the conservation picture might be the forest duikers (*Cephaloph spp*). Even while sustaining heavy hunting pressure, many of the forest duikers seem to be thriving, even in secondary forest habitat. Little is known, however, of Africa's rarest forest duiker, the Jentink's duiker (recorded only in Liberia and Ivory Coast). This unique animal is regarded as "white antelope" in Liberia and merits further study before its numbers are allowed to decline more. The dwarf forest buffalo is an adaptable species still wide spread in Liberia but hunted doggedly where sighted. This animal has adapted well to the savanna type habitat that now occurs along parts of Liberia's coastline. The bongo, one of the most magnificently marked forest antelopes, does exist in Liberia, but its numbers remain uncertain and unstudied.

Finally, the monkeys (including *Mangabeys cercocebus spp*, *Colobus colobus spp*, and *Guenons cercopithecus spp*), are perhaps one of the best indicators of the decline of wildlife species in Liberia. Once common and abundant in most rural and semirural communities, heavy hunting pressure has greatly reduced many species' numbers. Most monkeys (although some species continue to be agricultural pests), including the highly endangered olive colobus, *Colobus verus*, and Diana monkey, *Cercopithecus diana*, are restricted to remaining patches of primary forest.

3.   THE SAPO NATIONAL PARK:

The findings of the ecological survey gained the attraction of both local and international naturalists. As a result, it was preliminarily decided that one or two areas be identified for national parks. This resulted into the selection of Sapo National Forest being an area with less national interest for mineral resource exploitation. The first preliminary indepth study in the Sapo Forest was led by Dr. Phillip T. Robinson of the San Diego Zoo, California in early 1980. It was through this study that

tremendous efforts were made to establish the Sapo National Forest, the first national park of Liberia.

The original size of the Sapo National Forest was 378,000 acres or 590.9 square miles. The survey to establish the actual boundaries of the then proposed Sapo National Park deleted 85.6 square miles because of encroachment on the forest by settlements and farming activities.

The Sapo National Park obtained its actual status on 17th May, 1983 through Decree 73 of the then People's Redemption Council.

The Sapo National Park is one of the last remaining blocks of tropical lowland rain forest in Liberia. It was saved from logging because of the low grade commercial timber quality found there during the German Forestry Mission forest inventory of Liberia from 1960-1967. Again, the exploration for valuable mineral deposits did not materialize.

However, the park still faces tremendous pressure on all sides of its boundaries by timber concessions, farming and hunting. The staff of eight park guards, two rangers, two United States Peace Corps Volunteers and a park warden is far below the required administrative and manpower needs.

4. ROLE OF UNITED STATES PEACE CORPS:

The involvement of Peace Corps/Liberia in the conservation and development of the wildlife resources of Liberia goes back five (5) years, when the Forestry Development Authority requested volunteers to serve as wildlife technicians. In response to this request, two volunteers were assigned to the then proposed Sapo National Park. Further in 1984, the third volunteer joined the program.

Peace Corps involvement has not been limited to the provision of personnel. For over the past three (3) years, we continue to assist with human resource development, input supply and conservation of the valuable wildlife resources of Liberia. Volunteers in the program along with their Liberian counterparts have initiated an education awareness program in areas surrounding the park. In 1982, Peace Corps invited the participation of the Forestry Development Authority to the Forestry Workshop in Mombasa, Kenya. In addition, through the Peace Corps/USAID collaborative efforts, equipment and supplies were provided to the wildlife program amounting to over $7,000.00 (*Seven Thousand Dollars*).

Peace Corps/Liberia is committed towards the development of the Sapo National Park and the conservation of Liberia's wildlife resources. Hopefully, by proclaiming the Sapo National Forest as the first national park, we envisage working very closely with the Forestry Development Authority in identifying areas of priority. In the next three months to come, the future of Sapo will be determined by the convening of a workshop for the planning and management of the park. It is anticipated that this will develop the framework for designing a master plan.

CHAPTER 38

NIGER

THE CONSERVATION STATUS OF W NATIONAL PARK, NIGER

BY

BRIAN S. SHULL & JOHN GRETTENBERGER

1.   INTRODUCTION:

Covering 11,320 km^2, W National Park is one of the largest national parks in West Africa. It is a trinational park shared by Niger, Bourkina Fasso and Benin, and is widely recognized as being one of the most important parks in West Africa by virtue of its size and the diversity of habitats and species it contains (Douglas-Hamilton 1979, IUCN 1981). Its potential for tourist development is significant because of its proximity to the rapidly growing capital of Niamey, Niger and the burgeoning trans-Sahara tourist traffic.

However, because of poaching, illegal grazing, uncontrolled bush fires, the possibility of phosphate mining and dam construction, and the lack of financial and material means to combat these problems, the park and its wildlife are under constantly increasing pressure. This paper describes present conditions and problems in the Niger sector of W National Park and discusses possible solutions.

2.   DESCRIPTION:

The Niger sector of W National Park is situated in the southwest of the country, between the latitudes of 11°55' N and 12°35' N and the longitudes of 2°5' E and 2°50' E. It is bordered by the permanently flowing Niger River on the east, two seasonal rivers, the Tapoa and the Mekrou Rivers, on the north and south respectively, and the Bourkina Fasso frontier on the west. It covers approximately 2,190 km^2 in area. Average elevation is 250 m.

Soils are generally shallow and infertile with a high iron content, particularly, in the upland areas found in the park's interior. Depressions and stream valleys tend to have deeper, more fertile soils. Extensive rock outcroppings are found along the Niger and Mekrou Rivers.

Climatically, there is one rainy season and one dry season, which is divided into a cold season and a hot season. Annual rainfall is generally between 700-800 mm. and falls from May through early October.

3.   INFRASTRUCTURE AND FACILITIES:

W National Park of Niger is administered by the Direction of Forests and Wildlife which is part of the Ministry of Hydrology and Environment. Currently, there is a park director, eight guards and seven permanent workers posted at Tapoa, the park headquarters. In addition, there is one technical agent and one guard posted on the Niger River. Equipment at the disposal of the park administration includes a Land Rover, a dump truck and a road grader, although these are often nonfunctional because of a lack of funds for repairs and fuel. The budget for the park for the fiscal year 1984-85, excluding salaries for personnel, is 4,000,000 F CFA ($8,400).

Tourist facilities include a modern 25 room hotel which was constructed in 1981. A small museum is also maintained at the park entrance.

4. VEGETATION:

The park lies within the Sudan Savanna vegetation zone and the various vegetation types have been described by Koster (1981). A total of 463 species of plants have now been listed as occurring in the park (Grettenberger 1983). Combretum shrub savanna is the most widespread type found in the park, occurring on shallow infertile soils. Dominant shrubs are *Combretum micranthum*, *c. nigricans*, *Guiera senegalensis*, and *Acacia erthyocalyx*, and are usually 1-3 m. in height. Grass cover is dominated by annuals such as *Loudetia togoensis*, *Ctenium elegans* and *Hyparrhenia involucrata*. Combretum wooded savanna occurs on deeper, more porous soil and is quite variable in nature. Various associations can be grouped in this category, but they are generally dominated by trees such as *Combretum glutinosum*, *C.k collinum*, *C. nigricans*, *Crossopteryx febrifuga*, *Terminalia avicennioides* and *Piliostigma reticulatum*. Grass cover ranges up to 3 m. in height and is characterized by the annuals *Hypparhenia involucrata*, *Andropogon pseudapricus*, *A. fastiagatus* and the perennial *A. gayanus*. Riparian forest is found along all seasonal and permanent watercourses, although the width, density and species composition vary greatly depending on the terrain, soil and moisture availability. Dominant woody species include trees such as *Mitragyna inermis*, *Vitex chrysocarpa*, *Daniellia oliveri*, *Cola laurifolia*, *Diospyros spp.* and *Anogeissus leiocarpus* and shrubs such as *Mimosa pigra*, *Combretum micranthum* and *Acacia spp.*

W National Park is the only large relatively undisturbed tract of savanna wildland remaining in Niger and this is reflected in the large number of plant species occurring there which have not been found elsewhere in the country. Species of interest include the only two species of orchids recorded in Niger, *Eulophia cucullata* and *E. guineensis* and the insectivorous plant, *Drosera indica*, all of which are very sensitive to disturbances such as grazing and trampling. The park also contains the only significant remaining tracts of riparian forest in Niger, those outside the park having been largely cut down or degraded.

5. FAUNA:

Poche (1976) listed 79 species of mammals as having once occurred in the Niger sector of W National Park. The wild dog (*Lycaon pictus*), Cape clawless otter (*Aonyx capensis*), and the African manatee (*Trichechus senegalensis*) were all listed as being extinct, although the manatee is still occasionally reported just south of the park on the Niger River. Large mammals include all the species occurring in the West African savanna except the Derby eland (*taurotragus derbianus*) and the giraffe (*Giraffa camelopardalis*). The last census of large mammal populations took place in 1978 (Koster 1981) and another census is needed at this time. Several species merit special attention because of their rarity or recent changes in their numbers.

a. **Elephant** (*Loxodonta africana*):

In the early 1970s, the elephant population in the park during the dry season was reported to be 95 (Poche 1974), although this estimate was probably low. Significant numbers of elephants were instead reported to spend the dry season around permanent water up to 150 km. north of the

park. The 1978 aerial census, however, estimated the population at 600 $\pm$ 90 and their numbers appear to have increased in the last three years despite increasing poaching. Increased hunting, grazing and expansion of agriculture have been causing elephants to migrate into the park, as has been described elsewhere in Africa (Buechner, *et al*. 1963, Myers 1973). There has been an influx of elephants not only from outside the park, but also from the Benin and Bourkina Fasso sectors of W National Park where law enforcement is minimal. Even within the Niger sector, the elephants are concentrated in the middle half of the park because of heavy illegal activity along its borders. The resulting concentrations of elephants have resulted in increasing habitat damage, particularly in the riparian zones. Damage has been most severe along the Tapoa River where the construction of a dam in 1980 created a permanent water source near the park headquarters, where they are relatively safe from poaching.

b. **Buffalo** (*Syncerus caffer*):

Previously the most common large ungulate in the park, buffalo suffered from a rinderpest epidemic in 1981 that affected their populations in the entire region. No young were observed until late 1982. An estimated 50-60% reduction in their population took place.

c. **Topi** (*Damaliscus korrigum*):

This once widespread antelope has now become very rare in West Africa (Sayer 1982) and the regions of W National Park, Arli National Park in Bourkina Fasso and Pendjari National Park in Benin, now harbor the only viable population remaining west of Cameroon. W National Park is, therefore, a key area for the conservation of this species. An estimated 50-100 are present in the Niger sector.

d. **Hippopotamus** (*Hippopotamus amphibius*):

Although at one time common in the Niger and Mekrou Rivers, hunting has reduced the population to probably less than five individuals in the Mekrou River and ten individuals in the portion of the Niger River bordering the park.

e. **Leopard** (*Panthera pardus*):

Koster (1981) reported three sightings of leopards from 1974-1978, but no reliable sightings have been obtained since then, although tracks have been occasionally reported. The difficulty of observing this secretive, nocturnal species makes its status difficult to ascertain, but it is undoubtedly very rare because of hunting.

f. **Cheetah** (*Acinonyx jubatus*):

This cat is also very rare because of overhunting and a lack of suitable open habitat. Several sightings are made each year, however, and an estimated three to four pairs are probably present in the park.

More detailed description of some of the mammals can be found in Poche (1974a, b, 1975 and 1976) and Koster (1981). Koster and Grettenberger

(1983) have recorded 284 bird species as occurring in the park. This total has now risen to 299 bird species. A wide variety of herptofauna, including the Nile crocodile (*Crocililus niloticus*), Nile monitor (*Varanus niloticus*), pythons (*Python sebae* and *P. reguis*) and the land tortoise (*Testudo sulcata*), is also found.

MANAGEMENT PROBLEMS AND SOLUTIONS

5. POACHING:

Poaching is the most severe problem facing the park today and increases in intensity each year. Fortunately, hunting is primarily carried out with primitive weapons, handmade muzzleloaders which fire poison spears or slugs, or steel cable snares, and not with the modern weapons used elsewhere in Africa. However, these weapons are very inefficient, and it is not unusual to see elephants slowly dying from festering wounds caused by poison spear or roan antelope (*Hippotragus equinus*) and buffalo trailing snares.

Poaching is most intense during the dry season after the crops have been harvested and wildlife have concentrated around water. Typically, poachers set up their camps in the Benin or Bourkina Fasso portions of W National Park where there is little law enforcement and Nigerian authorities cannot follow. They then hunt as well as fish in the Niger part. The poached meat is smoked and transported with other commercially valuable products such as ivory and skins by bicycle, dugout or donkey. The meat is often shipped, via the Niger River, to Nigeria where a large sack of meat reputedly brings up to 50,000 F CFA ($105).

Several problems exist in controlling illegal activity which must be addressed:

a. Guards:

The present contingent of eight guards is hardly adequate to control a park of 2,190 km^2 in size, particularly when they are not adequately trained and morale is poor because of difficult living conditions. The number of guards needs to be greatly increased and they need to be trained in firearm handling and care, patrol methods and bushcraft. They and their families also need to be furnished with adequate living conditions.

b. Guard Posts:

One of the great barriers to efficient law enforcement is the lack of a permanent presence of guards in the park. In the past there were two permanent guard posts, but these were abandoned. The construction of a network of guard posts, permanently manned, is the only efficient means to control illegal activity, particularly along the frontiers.

c.   Transportation:

The lack of adequate transportation, either from mechanical problems or lack of fuel, is a severe barrier to law enforcement. It also results in a morale problem among the personnel because they are not able to get food and medical treatment, which are not available locally. A minimum of two properly maintained four-wheel drive vehicles with adequate fuel is a necessity. A motorized boat is also needed for patrolling the riparian areas along the Niger River.

d.   Tri-National Cooperation:

At present, each part of W National Park is administered separately and no agreement has been reached between Niger, Bourkina Fasso and Benin to coordinate law enforcement activities. Particularly important would be an agreement allowing the right of pursuit into another country when following poachers. This sort of agreement would most logically be reached under the auspices of the Parks and Reserves Committee of the Conseil de l'Entente.

e.   Education:

This final point is perhaps the most important because, in the long run, no park can exist without some degree of cooperation and understanding of the people living around it. There needs to be a program, perhaps similar to that in Senegal (Dupuy 1983), to educate the people as to the value of wildlife, and which goes hand-in-hand with a program to provide more employment through the park and to raise the standard of living in the area.

6.   ILLEGAL GRAZING:

Illegal grazing is another problem that has greatly increased since the early 1970s as a result of increased vaccination of livestock against trypanosomiasis, and periods of severe drought forcing herders to lead their livestock to greener parts of the country. The problem is most acute along the Niger River and the upper Tapoa River, where up to 10,000 sheep and cattle can be found during the dry season. This pressure has effectively displaced wildlife from the most productive habitat in the park. Loss of vegetation and erosion caused by trampling, overgrazing and cutting of browse has become severe. Wild predators are often poisoned or trapped to protect livestock as the scarcity of large predators is a direct result of these actions.

7.   FIRE:

Burning is a valuable management tool in savanna parks in West Africa, but if improperly used can have negative impacts on the soil, vegetation and water of an area. In the past, widespread burning has been conducted by park personnel in the areas most frequented by tourists for the purpose of:

a.   Improving visibility for wildlife viewing;

b.   Inducing a flush of perennial grasses for grazing animals; and

c.   Creation of firebreaks to prevent large scale late season fires.

In addition, large areas, particularly in the east and west, are burned by poachers and herders, resulting in over 75% of the park being burned each year.   This fire regime can lead to: a decrease in perennial grasses, an increase in fire resistant woody species, primarily Combretum spp., soil degradation and destruction of riparian forest.   This has caused the loss of unburned habitat particularly favored by elephants, buffalo and reedbuck (*Redunca redunca*).

With these additional considerations in mind, a fire management plan was drawn up in 1982, revised in 1984 and is being implemented this 1984-85 season.   The basic goals are to decrease the area burned, to be more specific in the vegetation type chosen to be burned, and to implement an early wet season burning program for the control of woody vegetation.

8.   WATER:

Water is one of the most important factors affecting animal distribution in the park.   A large number of natural waterholes exist in the park outside of the major riverbeds, but most of these dry up by January or February.   To improve the situation, a number of waterholes were created or improved, primarily along seasonal drainages.   In addition, a concrete dam was constructed in 1980 across the Tapoa River, which backs up water for 2-3 km. at the end of the dry season.   These waterholes are important because they provide alternate sources of water to the heavily poached Mekrou River Valley, and distribute wildlife into areas that would not normally be accessible.   This past year a major renovation was made to widen, deepen and repair broken walls of the 15 artificial waterholes and six of the natural waterholes.

9.   ROADS:

An adequate network of 474 km. of roads exists in the park with another road to be constructed this year.   These roads are repaired each year after the rainy season by a road grader and a crew of 10-20 workers. However, because of poor road placement, soil erosion and lack of permanent crossings on seasonal streams, the condition of the roads has deteriorated alarmingly making maintenance more difficult every year.   A large crew of workers needs to be employed to put in rock crossings, fill in gullies and dig runoff channels.   The possibility of employing crews of workers for annual road maintenance, as described by Sayer (1981) in Benin, should also be explored.   This would avoid the mechanical and fuel problems associated with the grader and would also provide economic benefits for the local populations.

10. TOURISM:

Presently, the park enjoys a fairly good tourist trade, primarily from residents of Niamey, but the potential exists for greatly increasing revenue and the number of visitors.

A total of 2,200 season permits were sold during the 1983-1984 season. A season permit presently costs 1,000 F CFA for the season. Nigeriens are admitted free.

There is also the problem of lack of transport for visitors. Currently, one must own a vehicle, or rent one in Niamey, which is very expensive, to enter the park. The purchase of a vehicle, either by the Bureau of Tourism or the hotel, would greatly increase visitation of the park, particularly by international travelers.

A variety of possibilities also exist for the development of boating, sport fishing, hides and camping, which would greatly enhance the park's attractiveness to tourists.

11. PEACE CORPS:

Peace Corps has been working with the Niger sector of the park since 1969, when the first volunteer was basically the acting director of the park in charge of all control and management activities. Today, there are two Volunteers stationed at the park, working as advisors to the park director on management practices and collecting scientific data for the park.

The projects currently being carried out by Peace Corps Volunteers are as follows:

a. **Waterhole Utilization Study**: to determine what species utilize the waterholes; times of utilization; numbers; group sizes; and interactions and feasibility of use of blinds by tourists.

b. **Application of Fire Management Program**: to increase tourist visibility; create fire breaks; promote new growth of grasses; control woody vegetation; attack wildlife; and satisfy specific needs of certain species of wildlife.

c. **Cattle Impact Study**: to determine the incidence of illegal cattle grazing; obtain records of animal sightings as an indication of competition; note effects of increased animal and human impact in Tamou Reserve as it affects the park due to the current drought in Niger.

d. **Park Monitoring**: gathering of large mammal and bird data; monitoring waterhole levels; checking for signs of poaching and illegal grazing.

e. **Museum Work**: continue work to upkeep and improve existing museum.

Possible new projects for 1984-85 season:

a. **Elephant Damage:** set up vegetation transects to monitor woody vegetation damage in the major elephant concentration areas.

b. **Tapoa Gorges Study:** to determine the feasibility of setting up a nature walk area close to the park hotel; wildlife species composition; plant composition; and human uses.

c. **Fire Plots:** to determine the long-term effects of fire on the vegetation under different burning regimes.

d. **Park Publicity:** to increase tourism; and to create a structured national and international publicity plan.

See the Appendix for a complete list of Peace Corps work at Park W.

12. CONCLUSION:

Niger is one of the poorest countries in the world and is beset by a host of problems ranging from periodic drought and desertification to a drop in world uranium prices, its primary export commodity. Not unexpectedly, wildlife has not received a particularly high priority. Niger has continued to support wildlife conservation, however, and the creation of the National Nature Reserve of the Air and Tenere last year, is evidence of this.

Because of a lack of trained personnel and financial means, Niger can only provide limited support for wildlife conservation and must continue to rely on international assistance if it is to be effective in protecting and developing its parks. This aid has not been forthcoming for W National Park, despite its importance, and it continues to function on the limited means available to it. The situation has reached very serious proportions, however, and if assistance is not forthcoming in the near future, a valuable part of Niger and West Africa's natural heritage will be irrevocably lost.

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APPENDIX

15 Years of PC Work at Park W

Richard Poche 1969-1972	Basically was acting director of park in charge of all control and management activities. Started ecological survey work, primarily on mammals of park.
John Sikbnen Paul Hahn Dave Dudwell 1972-1973	No real records of function although known to have aided in road construction. Began a bird list.
Jim Hempe Warren Montague 1973-1975	Made tourist questionnaire. Started herbarium. Heavily involved in road and waterhole construction. Survey of historical human populations and villages in the park. Study of illegal grazing and poaching in park. Business trip to Po National Park, Upper Volta and University of Ghana in Accra, Ghana to gather information and consult with authorities possible research projects for Park W. Also collected materials for collecting and preserving wildlife species. Fire management program was started. Assisted in making park map for tourists. Laid out plans for constructing a museum. Began a checklist of the park's avifauna - 157 spp. recorded.
Ben Kaghan Stan Koster 1975-1977	Helped build museum and furnish displays. Planned and supervised the construction of six waterholes and a couple of new roads. Began study in 1976 of the effects of fire on vegetation for two seasons (used fire plots). Conducted a total of seven ground and one aerial censuses over three dry seasons to complete the first complete census of large mammals of Park W. Vegetation survey in 1977-78. Continued bird species list - 256 spp. recorded.
Jeff Towner Dave Maerckline 1977-1978	Started vegetation map by continuing a general study of the topography and vegetation of the park. Started study on elephant feeding ecology.
Steve Seefeldt 1979	Continued vegetation map.
Glen Groben 1979-1980	Completed vegetation map.

John Grettenberger	Proposed an aerial census.
Tom McShane	Continued bird list - 284 spp. recorded.
1980-1982	Prepared a fire management plan/fire study.
	Started a study on the park drainages and waterholes to determine the distribution of water during the dry season.
	Study on elephant feeding ecology and its impact on woody vegetation.
	Prepared a management plan for the park.
	Collected bat, rodent, reptile, plants, etc., specimens.
Sam Pett	Survey of illegal cattle grazing.
1981-1982	Aided in aerial census proposal.
	Waterhole management.
Mary Mahaffy	Study on waterhole utilization.
1982-1984	General road censusing of larger mammals.
Steve Gardes	Survey of human impact on Mt. Tapoa-Zerma.
1983	Tourist survey.
	Continued bird list - 295 spp. recorded.
	Inventory of illegal activities in park.
	Attempted controlled burning program Oct. 1983.
Brian Shull	Continuing study of waterhole utilization.
3/84 - present	Implementing fire management program.
Kim Moore	Survey of human impact on park perimeters.
10/84 - present	Continuing bird list - 299 spp. recorded.
	General road censusing of larger mammals.

All of the volunteers have helped with the following:

        Curator for the museum and herbarium.
        Assisted in law enforcement of illegal activities in the park.
        Assisted in road maintenance and construction.
        Collected all meteorological data for park to be supplied to the Niger government.
        Park tourism.
        Curator of park's scientific library.

CHAPTER 39

A HUMAN DIMENSION TO NATURAL RESOURCE CONSERVATION

A CASE STUDY FROM NIGER

BY

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1. INTRODUCTION:

The Republic of Niger is currently in the process of establishing a vast, new national nature reserve in its northern desert zone. Although the legislation gazetting the protected area has yet to be enacted, management and administrative infrastructures have already been installed. Technical and financial assistance is being provided by the International Union for Conservation of Nature and Natural Resources (IUCN) and the World Wildlife Fund (WWF). The project is being executed by personnel from Niger's Forests and Wildlife Service.

The decision to establish a reserve rather than a national park was made primarily to enable the area's inhabitants to continue living in the area. Principally nomadic herdsmen, the people will retain their customary rights of residence, passage, access to water, pasturage, gardening and the collection of forest products such as firewood, fruit and medical plants. Legislation will control a wide range of activities from hunting to the overexploitation of woody vegetation, and from tourism to the modification of the habitat by mining or other forms of development. To facilitate management and conservation of endangered wildlife, a core-zone strict nature reserve is also proposed.

On the whole, legislation governing these activities has existed nationally for a number of years. Hunting, for example, was banned in 1964 and a list of protected trees drawn up as early as 1935. Although the practicalities of law enforcement might pose some problems, no major new legislation need be enacted to strengthen the reserve's juridical base. However, when considering the population's dependence on the reserve's natural resources, it needs to be decided to what degree resource use can be permitted to satisfy local needs for forage, household utensils and construction wood.

It is evident that a potentially large area of conflict exists because of the differences between the rather nonspecific conservation-oriented legislation and the land use practices currently employed by the people. During a recently held National Debate on Desertification (May 1984), Nigerien politicians and technicians stressed the need for less destructive land use practices. Hopefully, careful thought and evaluation will avoid overzealous suppression of basically sound activities such as nomadism. For the new reserve, a policy defining the limits of permissible natural resource use and clarifying the conflicting issues is required. The results should be subsequently reflected in the reserve's constitution and legislation. This article describes the main areas of conflict and forwards some proposals for their solution.

2. THE AIR AND TENERE NATIONAL NATURE RESERVE:

Full details of the physical and biological aspects of the proposed Air and Tenere National Nature Reserve can be found in Newby (1982), Grettenberger and Newby (1984) and Grettenberger, Newby and Monson (1984) For the purposes of this paper, the following summary will suffice as an introduction to the area.

Fig. 1. Situation of the proposed Aïr and Ténéré National Nature Reserve.
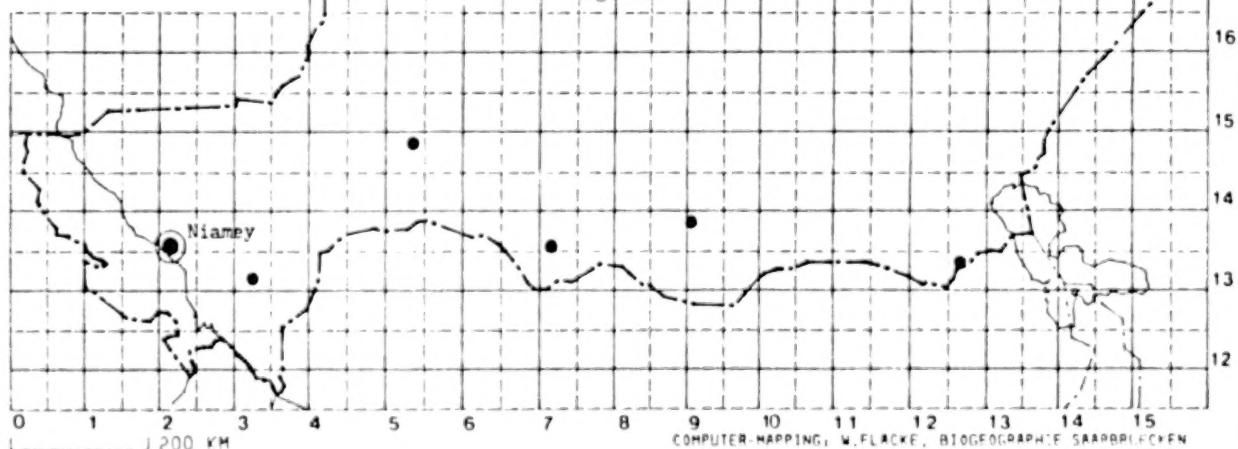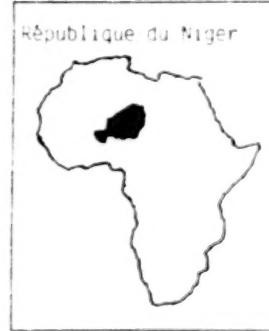
The proposed reserve is located in Northern Niger and lies approximately between latitudes 17°00' and 20°30' North and longitudes 08°00' and 11°00' East (Figure 1). Covering 77,360 km², the reserve encompasses a wide variety of arid and hyperarid habitats, ranging from the extensive regs and ergs of the Tenere to the more clement mountain and valley habitats of the Air Massif. An area covering about 12% of the total has been proposed as a core-zone strict nature reserve. Elevations range from around 500 m in the Tenere to just under 2,000 m on Mt. Tamgak.

Annual rainfall ranges from 0-75 mm and falls during the months of July, August and September. Orographic effects cause rainfall to be highest in the mountains, but many areas remain without rain for years at a time. Daytime temperatures are high, rising to 45-50°C in May and June and diurnal fluctuations regularly attain 20 degrees. During the coldest months of December and January, temperatures drop to 0° to -4°C in the mountains. Average annual maximum and minimum temperatures are in the order of 35°C and 15°C respectively.

Vegetation is on the whole sparse and closely associated with the drainage features (wadis, flood plains and rock-pools). This is particularly marked along the more regularly flooded wadis where vegetation may be quite dense. The woody strata is composed of trees such as *Acacia tortilis*, *A. albida*, *Balanites aegyptiaca* and *Maerua crassifolia*. Herbaceous vegetation is dominated by perennial, tussock-forming grasses like *Panicum turgidum*, *Cymbopogon schoenanthus* and *Stipagrostis vulnerans*, and by hardy forbs such as *Aerva javanica*, *Pergularia tomentosa* and *Chrozophora brocchiana*. Annuals are generally seasonal or ephemeral in occurrence.

The reserve's large mammal fauna is typical of the Sahelo-Saharan zone and includes addax (*Addax nasomaculatus*), dama, dorcas and slender-horned gazelles (*Gazella dama*, *G. dorcas*, *G. leptoceros*), Barbary sheep (*Ammotragus lervia*) and very rarely the scimitar-horned oryx (*Oryx dammah*). Carnivores include the striped hyaena (*Hyaena hyaena*), common jackal (*Canis aureus*) and the fennec (*Fennecus zerda*). The area's avifauna is rich and includes the ostrich (*Struthio camelus*) and the Nubian bastard (*Neotis nuba*). Of the 130 bird species so far recorded, about 40% are Palearctic migrants (Newby, Grettenberger and Watkins, in prep.)

The area covered by the reserve is inhabited almost exclusively by Twaregs (Imajaghan), a nomadic people of Berber descent. Twaregs are principally pastoralists, raising camels, goats and sheep, but they also undertake small-scale irrigated agriculture of wheat, maize, onions, tomatoes, peppers, etc. Many families are also involved in the "triangular," camel-based caravan trade between the Air, the salt and the date producing oases of the Kawar and Fachi, and the sub-Sahelian grain producing regions of Niger and Northern Nigeria. Although the need for the products of the caravan trade still exists, the practice and profitability of the undertaking has been badly hit by the prolonged drought (decline in fitness and quantity of suitable caravan camels) and by the increase in competition for motorized traffic. According to the last census (1977), the population of the area covered by the proposed reserve was 2,600. Emigration to the neighboring mining centers has been an important

demographic factor, as has the prolonged drought. Of the total population, some 8-900 are sedentarized in and around Iferouane, the Northern Air's main administrative center. Further, small sedentarized populations exist in the gardening centers of Tin Tellous and Zomo. The remainder of the population follows its pastoral existence in and around the Air Massif.

3.   **NATURAL RESOURCE USE**:

As already indicated, the traditional economy of the Air is founded on three main activities--pastoralism, irrigated gardening and the caravan trade.   These are highly interrelated complimentary activities and many Twareg families try to maintain an interest in all three. Produce from the gardens and livestock is traded for salt and dates in the desert oases. These are then bartered for the grain, cloth, sugar and other necessities unobtainable in the Air.   It is clear that an economy of this nature depends to a great extent on the ability to sustain a way of life based on the wise use of natural resources. In many ways, it can be argued that the only way the people of the Air can exist with any permanence in such an arid environment, is through the exploitation of as diverse an array as possible, of naturally occurring resources.   Unfortunately, various political, social and economic factors are gnawing away at the foundations of the Twaregs' economy and social fabric.   Drought and subsequent famine are a constant threat.   Fundamental to the well-being of the Air's population is the need to come to terms with the cycle of events that are causing the environmental crisis that is affecting most of the world's arid regions today--overexploitation of natural resources, abusive or in-appropriate land use practices, overpopulation, desertification and famine.

The establishment of a large protected area in the Air will provide an excellent opportunity for the rational management of natural resources. The very fact that the human population of the area is recognized as being a fundamental component of the ecosystem and not expelled to simplify matters, will add validity and relevancy to the work.   The following sections describe the relationship between man and the major living resources of the proposed reserve.

4.   **WILDLIFE**:

Wildlife as a source of food or as a trade item was, in the past, a significant resource for the people of the Air.   Over the past 60 years or so, wildlife has not only become scarcer but the absolute wealth of the nomads, in terms of livestock owned, has seen periods of marked increase. Drought has once again reduced stock levels to below that required for survival.   Although dependence on wildlife is today insignificant, this could be increased.

With the exception of particularly rare species, traditional hunting is probably still largely sustainable in the arid lands of Africa. Evidence from the Air supports this statement.   Hunting is localized and overwhelmingly artisanal in nature.   Hunting with firearms and from vehicles remains the monopoly of government and expatriate personnel. Within the proposed reserve, tourism is, in fact, probably the greatest non-natural threat to wildlife, especially the endangered species. Animals are hunted and harassed throughout the year.   Unwittingly or not, addax,

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gazelles and ostrich are subjected to high speed chases by the drivers of desert-going vehicles. As in so many of the world's protected areas, the management of tourism is often as problematic as that of the natural resources themselves.

Although the prolonged drought in the Sahel is having extremely serious effects on wildlife numbers, the fauna is well adapted to cope with this (Newby 1984). In general terms, arid land wildlife is able to utilize in a sustained manner, vast areas of marginal pastoral land that are unexploitable by domestic stock on anything but a seasonal or ephemeral basis. In the light of habitat loss and impoverishment from desertification, and the catastrophic effects of drought on livestock numbers (not to mention their contribution to environmental degradation), the economic and ecological values of wildlife should be looked into closely and research undertaken to ascertain the feasibility of trying to exploit it on a sustained-yield basis.

The status of the reserve's major wildlife species and the impact locally of man upon them, can be summarized as follows:

a. __Addax__:

The addax used to be hunted on camelback or stalked with trained dogs. Over the past 30-40 years, mechanized overhunting has reduced its number to such an extent that traditional hunting on a regular basis no longer occurs. In the less accessible parts of its range, the addax is severely threatened by disturbance from tourism and more topically, from the effects of prolonged drought. Addax meat used to be an important source of protein and when dried, formed with the excellent hides, a lucrative trade commodity. In addition, the addax's bone marrow is prized as a most effective remedy for snakebite and scorpion stings.

b. __Dama and Dorcas Gazelles__:

Both these species are traditionally hunted with locally made foot-traps and snares that are set in the vicinity of attractive shade trees or in areas of good grazing. Whilst the ubiquitous dorcas gazelle is not infrequently trapped, the much rarer dama gazelle is seldom so. In terms of a threat to the survival of the dorcas gazelle, hunting at present levels is insignificant. If it were practically feasible, the culling of small numbers of dorcas gazelles might provide a complimentary source of protein and supply of trophies and leather for the tourist trade.

c. __Barbary Sheep__:

Traditionally, Barbary sheep have been mainly hunted by local experts using specially trained packs of dogs. Snares are used in areas or on tracks regularly used by the sheep. Hunting with dogs is practiced during the wet and cold seasons when the sheep come down from the mountains to breed and feed in the lower and more accessible foothills and valleys. Barbary sheep meat is highly prized, as are the hides that are used for the confection of the Twaregs' tents. In the Northern Air, at least the species is reasonably common and it is unlikely that the few local hunters have any real impact on overall numbers. If there is any scope for sport

hunting within the reserve, the Barbary sheep is the obvious animal to exploit.

d. Ostrich:

The Air is one of the last strongholds of the ostrich in the Sahara. With few exceptions, the Twaregs of the proposed reserve find ostrich meat distasteful and leave the birds alone. Nests, when robbed of their eggs, are rarely totally rifled. The ostrich is esteemed by the nomads as part of their culture and environment and as such, worthy of their respect. This attitude, which is equally applied to the large mammals like the addax and dama gazelle, will go a long way in claiming the support of the local population for wildlife protection measures.

As is evident, the ban on hunting will have little effect on the present lifestyle of the average Twareg: most do not hunt, no sector of the population is dependent on the wildlife resource and in theory, at least, hunting is nationally prohibited.

5. LIVESTOCK PREDATION:

In areas where both livestock and predators coexist, conflict inevitably occurs between herders and conservationists: the proposed reserve is no exception. This is a major problem since, as threatened species, the predators also need protection. Under drought conditions, livestock fall easy prey to predators--losses that the herders can ill-afford. The impact of the predators can be summarized:

a. Common Jackal:

The jackal is by far the commonest of the larger predators occurring in the reserve and is blamed for the majority of predator-related livestock losses. Elsewhere in Niger, it was shown that the majority of the jackal's diet consisted of rodents, fruits and insects, and that livestock was only rarely taken (McShane and Grettenberger 1984). Under the harsher conditions of the Air, it would seem that natural food is much harder to come by and that livestock is a more important dietary component.

b. Striped Hyaena:

Although once common in the Air, striped hyaenas have been persecuted and their numbers drastically reduced by poisoning, trapping and the systematic destruction of their breeding lairs. The last wild dogs (*Lycaon pictus*) were exterminated similarly in the Air in the 1950s. The few remaining hyaenas have become extremely wary and stick to the ruggedest of country rich in natural shelters. Livestock predation by hyaenas is rare. Their favorite prey, feral donkeys, are abundant and are in fact a serious drain on limited pastoral resources.

c. Cheetah:

The status of the cheetah (*Acinonyx jubatus*) is particularly precarious with only an estimated 15-20 living in the reserve. Although occasionally blamed for livestock losses and persecuted accordingly,

cheetah's rarity and predilection for natural prey leave it largely unharassed.

In addition to the predators already mentioned, the caracal (*Felis caracal*) and the honey badger (*Mellivora capensis*) are occasionally blamed for livestock losses (chickens, kids and lambs). Apart from the herders, the gardeners also have complaints, citing jackals, hedgehogs (*Atelerix albiventris*) and especially, the porcupine (*Hystrix cristata*) as pests. The latter causes considerable damage to tomato, corn and melon crops.

The question of predators is one that is raised repeatedly in discussions with the area's inhabitants and although the extent of losses is yet to be quantified, it is inevitable that some concessions will have to be made. Whatever the policy, the cheetah must be totally protected and the control of hyaenas limited to adequately substantiated cases only. The use of poisons will be restricted to specific cases where they will be used exclusively by qualified personnel able to insure that nontarget species are not affected.

6. <u>AVIAN CROP DAMAGE</u>:

Although a localized occupation within the reserve, gardening is socially and economically very important. In and around Iferouane, some 100 gardens are currently exploited and at Tin Tellous and Zomo there are a further 25. Although relatively tiny in area (less than 1 ha), these garden "oases" provide abundant food, water and shade for bird life. Both the Senegal firefinch (*Lagonistica senegala*) and the warbling silverbill (*Lonchura malabarica*) are restricted almost exclusively to them. They also serve as important watering and resting places for resident species and Paleartic migrants alike.

Whilst protection of the avifauna is essential, it is recognized that birds can cause considerable and ill-affordable damage to crops. Gardeners are obliged to mount permanent watches over their gardens, chasing birds away or killing them with catapults, mousetraps and snares. Ongoing studies reveal that the majority of crop damage is caused by a small number of species. As some of the most abundant garden birds, the warbling silverbill, the grey-headed sparrow (*Passer griseus*) and the trumpeter bullfinch (*Rhodopechys githaginea*), inflict heavy damage on grain crops. Fantailed ravens (*Corvus rhipidurus*), vitelline and slender-billed weavers (*Ploceus velatus*, *P. luteolus*) and the golden sparrow (*Passer luteus*) are also major culprits. Dates are a crop prone to bird damage, even though the ripe fruit are protected with burlap sacking or woven matting. Here it is the fantailed raven, the pied crow (*Corvus albus*) and the blue-naped mousebird (*Colius macrourus*) that are primarily responsible.

Whilst the killing of birds, even by primitive methods, would in theory, be illegal within the reserve, a compromise needs to be sought. It would appear that since the most harmful species are common, there is little reason to ban traditional methods of crop protection so long as nontarget species are left alone.

7. VEGETATION:

As Newby (1982) has underlined, the condition of the vegetation in the region covered by the reserve has reached a very disquieting state. A combination of drought, overuse and abusive cropping practices has resulted over the past 20 years in a serious deterioration of the vegetation and especially of the trees and shrubs. The continued existence of both human and wildlife populations depends on the maintenance of healthy vegetation. It provides forage and shade for both wildlife and livestock, produces a wide variety of products and materials for the people and acts as a living barrier against desertification and soil erosion.

a. Woody Vegetation as Forage:

In spite of drought, the greatest threat to the survival of the reserve's woody vegetation is overuse as animal fodder. Because of the nature of the terrain and the distribution, quantity and nature of water, and pastoral resources, the Twaregs of the Air are much more sedentary than the nomads of the pastoral zone to the south. They are considerably more dependent on woody vegetation for browse and aerial forage. The majority of herders recognize the need to conserve shrubs and trees and only lop small branches or use long, hooked poles with which to dislodge pods and leaves. There is, however, a persistent minority that cuts large branches and fells entire trees to obtain forage for its stock. This practice, combined with prolonged drought, has been instrumental in the wholesale destruction of trees seen in the reserve and surrounding countryside. A certain amount of trimming and pruning can be supported by the trees and may, in fact, increase the quality and quantity of forage produced. Trimming of small branches should, therefore, be permitted implicitly at least, as this is the only way of utilizing the highest strata of the trees and of producing the right kind of forage for young animals.

b. Trees as a Source of Wood:

As a people located far from the population centers and markets with manufactured goods, the Twaregs of the reserve are highly dependent on trees for the production of many of their household necessities. The enforcement of a total ban on "abusive" cutting of trees will weigh heavily on the population and particularly on the "iklan" (former slaves) and the "inadan" (blacksmiths and artisans) castes, who depend on woodworking for part of their livelihoods.

The uses of the most important trees of the reserve can be summarized:

(i) Acacia Albida:

This is one of the most useful and one of the most endangered species of tree in the reserve. As a forage tree it has few rivals but because of its large size and the nature of its easily-worked wood, it is used to make big objects like mortars, drums, drinking troughs, bedposts, etc. The fabrication of these items often necessitates the use of the trunk and larger branches and there is hardly a tree in the reserve that has not been ravaged. Its overexploitation is not only a result of its use locally, but also because of exports to the Southern Air and to neighboring Algeria.

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(ii)   Acacia Tortilis:

Ecologically, *Acacia tortilis* is the most important tree in the reserve: it is abundant, drought resistant and has a high forage value. It also provides wood for construction and for well reinforcement, bark for rope making and is also used as an alternative in the manufacture of tool handles, pestles, saddlery, etc.

(iii)   Acacia Nilotica:

The wood of this locally rare tree is hard and durable and is used in the construction of huts, pestles, tool handles and luggage racks. The seed pods are used to tan leather with.

(iv)   Acacia Ehrenbergiana:

The bark of this important forage tree is used for rope making and as a tanning agent in the confection of waterskins and leather buckets.

(v)   Balanites Aegyptiaca:

An important tree for the making of all manner of household utensils-- spoons, ladles, handles, poles, etc. The fruit ("desert date") is edible, oil can be extracted from the "nut."

(vi)   Ziziphus Spina-Christi:

This important shade and forage tree produces a nutritious fruit ("jujube"), bark for tanning leather and hardwood for such specialized items as pulley wheels for wells, luggage hangers and the upright trees on camel saddles.

(vii)   Calatropis Procera:

The light wood of this shrub is used in the manufacture of camel saddles, drinking troughs, milking bowls and beds. Dried branches are used to build stockades and being termite-resistant, the wood is used as a lining material in roofs.

(viii)   Hyphaene Thebaica:

The "doum" palm is suffering from acute overexploitation. It only grows in any number along the banks of one wadi and here falling groundwater tables are seriously constraining growth and regeneration. When sprouting, the leaves are cut, cured and dried to make ropes, matting, hut walls and woven household utensils such as bowls, measures and platters for the grading and winnowing of cereals. The strong, fibrous wood is termite-resistant and the favorite timber for construction and for the fabrication of water runnels and sluiceways for the irrigated gardens.

Considering the widespread need for wood and forest products, legislation aimed at insuring the conservation of trees and shrubs must be realistic. On a national level, a list of 11 protected trees was drawn up

as early as 1935. The list was modified in 1974 and expanded to 15. Of these, six are found in the reserve, although only *Acacia albida*, *A. nilotica*, *Balanites aegyptiaca* and *Hyphaene thebaica* are current. The other two, *Acacia senegal* and *Tamarindus indica*, are much rarer and confined to high-altitude plateaux. A flexible system needs to be devised and applied to insure that the reserve's residents are not deprived of vital requirements. Legislation must clearly define the acceptable limits of tree and shrub use. If large scale destruction was halted, limited amounts of lopping and pruning could be allowed for most species. An internal list of totally and partially protected trees needs to be drawn up and a permit and quota system established for artisans. Cutting could be restricted to certain areas only, creating a dynamic zonation of the reserve to accommodate for varying degrees and types of land use whilst establishing areas for recovery, regeneration and rehabilitation of vegetation.

8. GARDENING:

Although gardening activities within the reserve will not be curtailed, clarifications need to be made concerning such activities as lopping of trees to build thorn fences, clearance of land for new or reclaimed gardens and the protection of wadi banks from erosion. A garden policy needs to be drawn up and included in the reserve's legislation. This would ideally also include a statement on reforestation and agroforestry obligations as well. This type of approach would be particularly significant to the Iferouane area, where the majority of gardening takes places. The area is deceivingly well-wooded, but the trees (mostly *A. tortilis*) are overmature and because of lack of rainfall and chronic overgrazing, virtually no regeneration has taken place in the last 40-60 years. Most significantly, the only place where stands of young trees can be seen is in the gardens. With protection from foraging goats, the trees are able to establish themselves to the extent that they can support normal grazing pressure in most areas. Gardeners should be encouraged to increase the number of trees on their land by providing them with technical assistance and seedlings of the most useful local species. Likewise, simple agroforestry techniques need to be demonstrated and applied, especially in the fields of live-fencing, windbreaks and bank stabilization.

9. CONCLUSIONS:

As is well evident, the problems inherent in managing a protected area, especially one the size of the Air and Tenere National Nature Reserve are complex and numerous. It would certainly be easier just to evict the human population from the area, but to ignore the human dimension in natural resource conservation is to ignore the realities of the world we live in. At present, the majority of the reserve's population appreciates the need for restrictions controlling the obvious destruction of their natural resources. Nonetheless, this same majority could quickly become alienated if the rules and regulations were so inflexible as to render impossible its already meager day-to-day existence. This is a real fear and as such, the people already view the reserve with apprehension.

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To allay fears of this nature, it is absolutely essential that reasonable concessions be made and that the regulations be flexible enough o accommodate for the needs of the people whilst protecting those resources that require it the most. The combination of a sound and enlightened natural resource management plan and sensible legislation must be backed up by useful complimentary activities, if the idea of a reserve is to be accepted. One field in which progress has already been made is construction. With the technical assistance of a Canadian-based PVO, the Institute for the Study and Application of Integrated Development (ISAID), adobe houses have been built with domed and vaulted roofs using no wood at all. Even though natural roofing materials are in short supply, it is little use forbidding their use unless an acceptable alternative can be provided. Likewise, legislation governing the use of firewood would be more acceptable if accompanied by the introduction of inexpensive, efficient woodburning stoves.

Unless the quality of life of the reserve's inhabitants can be improved, or at least maintained, it is unlikely that they will support the sort of stringent measures increasingly required to solve the Sahel's environmental problems. The process, if at all possible, will be a long one, but unless it is started, the days of the Air's population are very definitely numbered.

This document makes no claim at being a comprehensive resource management plan, but it does attempt to highlight some of the issues at stake in a small area of Northern Niger. Whilst it is recognized that the local conditions have their own unique character, it is hoped that future work in the Air will help define a methodology that might find its application elsewhere in the Sahel. "Shotgun" development, aimed at the solution of vast and complex problems with enormous sums of money, has been found to be lacking. Development and conservation are inextricably interrelated, the latter in many ways the *sine qua non* of the former; the former unattainable in the absence of the latter. Development and the solution of environmental problems like desertification have to be more site-specific if they are to succeed. The process might well take a long time, but better make progress slowly than not at all. Furthermore, site-specific initiatives can take into consideration the very natural resources that conservation and development should ultimately be all about--human beings.

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CHAPTER 40

BURKINA FASO: PEACE CORPS

BURKINA FASO WILDLIFE/PARKS PROJECTS

BY

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1. INTRODUCTION:

Burkina Faso (formerly Upper Volta) is a landlocked West African nation of 274,000 km^2 and seven million inhabitants. The population, composed of more than 30 ethnic groups, is primarily rural and approximately 90% of the people are small farmers or herdsmen. These people are unevenly distributed throughout the country with the central region having the highest densities.

Climate conditions vary considerably between regions of the country. Rainfall, falling mostly between the months of May and October, ranges from 400 mm per year in the extreme north to 1,100 mm per year in the south. As with most Sahelian countries, the rainfall has been lower than usual in recent years, leading to problems with water and food availability. Temperatures range from lows of 10-20°C in December to over 40°C in the month of March.

This presentation is primarily concerned with parks and wildlife conservation in Burkina Faso, and the involvement of Peace Corps in that program. At present, there are three Peace Corps wildlife biologists working in the country, all with Nazinga Wildlife Utilization Project, an experimental game ranch project. Therefore, the conservation of parks and wildlife programs in Burkina Faso will first be discussed and then the Nazinga project more specifically.

2. PARKS AND WILDLIFE CONSERVATION IN BURKINA FASO:

The management of national parks, wildlife reserves and hunting is the concern of one of three departments under the Ministry of Environment and Tourism. The stated goal of wildlife conservation in the country is to "conserve the diversity of all wildlife resources and organize the development of all their durable uses."

At present in the country, there is one national park, Po (1,555 km^2), five total wildlife reserves (approximately 6,500 km^2), five partial wildlife reserves and several areas designated as classified forests. Hunting has been closed in Burkina Faso since 1980, so there is little difference in legislative protection afforded wildlife between these different conservation area designations. Since 1979, with the financial and technical assistance of UNDP/FAO, the parks department has been conducting an inventory of wildlife resources throughout the conservation areas of the country. The goal of this inventory is to improve the present network of management areas nationwide, taking biological and socio-economic factors into consideration. To this end, a proposal has been made to reorganize this network by expanding the number of national parks to five by redesignating 5,200 km^2 of wildlife reserve and forest land, and by creating two migratory bird sanctuaries in the north, two experimental game ranches, two biosphere reserves, and buffer zones of limited utilization around the parks.

Conservation efforts in Burkina Faso have faced many problems. Among these, a lack of adequate funds and trained manpower has likely been the largest problem in implementing conservation efforts. Also, the regulations of the parks department used in protecting conservation areas have

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often conflicted with the uses of the land desired by local populations and illegal hunting, fishing, agricultural uses, grazing, wood harvesting and fires are all widespread in protected areas. Finally, environmental factors including recent low rainfall, degradation of vegetation cover due to excessive burning and serious erosion along waterways have all acted to impede the attainment of conservation goals.

In an effort to establish conservation priorities for the nation, and to discuss the principle problems at present and anticipated, the parks department has organized a national seminar to be held in November. It will be attended by department personnel, foresters, other government officials and villagers living near the park areas. The possibilities of initiating experimental hunts will also be discussed. It is hoped that this program and a schedule of regional seminars will alleviate some of the present misunderstandings between conservation officials and villagers.

3.   NAZINGA WILDLIFE UTILIZATION PROJECT:

The Nazinga Wildlife Utilization Project was approved by the Burkinabe government in 1979, although initial planning work was begun by Clark Lungren, a Canadian, beginning in 1974. The project was envisioned as a five-year undertaking with the following immediate objectives:

a.   To initiate research on the practical aspects of game ranching in Burkina Faso;

b.   To furnish biological data on West African ungulates of potential use in a game ranching operation;

c.   To furnish data on the carrying capacities of the various habitat type present; and,

d.   To examine the effects of grazing on those habitats.

The long-range goals of the project were to:

a.   Contribute towards the development of a meat-producing industry in Sahelian countries; and

b.   Aid in teaching rural people an appreciation of the benefits of conservation and rational land use.

The existing forms of land use in the country are primarily small-scale agriculture, often using slash-and-burn techniques and cattle herding. Periodic droughts and the generally poor soils limit the production of both these activities, and food shortages and protein deficiencies are commonplace. The impetus for the project was the observation that a nondestructive form of land use, such as a game ranch, could be an appropriate use for protein production of marginal lands without damaging those lands.

As first proposed, the project entailed stocking a 16 km^2 paddock with nine species of native ungulates at higher density levels than those in game-rich areas of Burkina Faso. These would be observed and studied for a

period of three years, along with any vegetation changes occurring. After this period, a review of the results of this experiment would be made, and if the results suggested that suitable densities could be supported, the project would be further developed.

It was proposed at this time to enlarge the project zone to 242 km^2, develop roads, dams, slaughter facilities and begin initial harvesting of wildlife. At the end of five years, the project would be turned over to the Burkinabe government, if successful, a self-sustaining game ranch.

A project such as this would benefit the local population in several ways. Meat produced on the ranch would be sold to local villagers at a reduced rate providing a protein source. Also, the development of dams would provide fishing opportunities and an additional food source. Employment would be available on the ranch to the villagers, particularly during the ranch's development stage. Also, once animals were harvested, a trade in animal hides and byproducts could be undertaken by local people for further economic benefit. The building of roads and the tourism the project would likely attract, would encourage better development of medical and educational facilities in the area. Finally, once in operation, the game ranch could act as an education center for students on wildlife and conservation topics.

A project zone was chosen in the southern region of the country on the Ghanaian border. The area was chosen for several reasons--it is relatively accessible to the large population centers of the country (Ouagadougou and Bobo-Dioulasso), the Sissili River and several smaller seasonal rivers run through the area, there are a variety of habitat types available for wildlife, the area has a history of relatively high game densities and the region was nearly uninhabited. As agreed upon with the government, a zone of 860 km^2 was designated for the project to be administered jointly by the government and the African Wildlife Husbandry Development Association, a private Canadian nonprofit organization. Topographically, the area is rather flat, broken by granitic and laterite outcroppings and river gullies. The soils are mostly heavy mineral soils, and the vegetation a typical West African mixture of tall grass, tree and shrub savanna and Sudanian savanna woodland. *Vitellaria paradoxa* is the dominant tree species in much of the area, and *Andropogon* and *Hyparrhenia* grass species dominate. Mammal species present, potentially important for the game ranch, include roan antelope (*Hippotragus equinus*), western hartebeest (*Alcelaphus buselaphus*), Defassa waterbuck (*Kobus defassa*), African buffalo (*Syncerus caffer*), African elephant (*Loxodonta africana*), warthog (*Phacochoerus aethiopicus*), and the reintroduction of the locally-exterminated kob (*Kobus Kob*) was proposed. Wildlife densities in the area had been greatly reduced, primarily due to poaching, both locally and by poachers from Ghana, and it was suggested that with protection, the population would increase to former levels.

September of 1984 marked the end of the initial five-year project contract, and though the project has been extended for another three years, it is a good time to review what has and has not been accomplished thus far. There is certainly no operating game ranch present at Nazinga, nor has any harvesting of animals yet been attempted. Due primarily to financial and manpower shortages, both the development of the ranch

facilities and the research program are behind schedule. The first five years of the Nazinga project have been important, however, in its experiences and accomplishments.

The research program of the project has been considerably modified since its inception. Research went quite slowly during the project's first three years, also due mostly to manpower and financial shortages. During that time, however, a herbarium was made, an initial vegetation map of the project zone was made, a vegetation survey of the 16 km^2 research paddock was made and a trap constructed for capturing research animals. In 1982, Dr. C.A. Spinage of FAO gave better direction to the research program with a formal revised research plan aimed at realizing the project's objectives. The program entails conducting the following research programs, more or less in the order of priority: regular wildlife censuses, collection of meteorological data, grassland composition study, primary productivity determination, woody vegetation composition and productivity studies, establishment of an accurate vegetation map of the project zone, dietary study of principal herbivores, determination of the effects of fire on vegetation, study of grazing effects on vegetation, recording of vital statistics of principal herbivores, and a behavior and habitat use study of the important species. The involvement of Peace Corps with the Nazinga project is primarily with the research program. At present, regular censuses of wildlife on the ranch are being conducted using line transect censusing, meteorological data is being collected, studies of primary productivity and behavior and habitat use of the principal herbivores have recently been completed and studies of grassland composition, woody vegetation composition and productivity, dietary habits, and the effects of fire on vegetation are presently underway. Also, due to anticipated problems with elephant damage, the proposed 16 km^2 research paddock has been scaled down to four adjoining 1 km^2 paddocks, each stocked at different densities to aid in the determination of the area's carrying capacity. Thus far, two of the enclosures have been built, and one stocked with a herd of 14 roan antelopes (although three hartebeest and four roan antelopes have subsequently entered).

The project's most important accomplishments have been in terms of working successfully with the Burkinabe government and the local villagers. The government has been quite willing and enthusiastic in cooperating to try and make the project successful. Burkinabe Eaux et Forets agents work at the ranch with antipoaching and public relations programs, and cooperate with the research program. Lack of adequate finances and manpower has limited the number of agents present as well. Relations with neighboring villages are quite good, and the majority of ranch workers come from these villages. Also, six dams have been built thus far on the Sissili and Dawavele Rivers, providing approximately 25 kilometers of year-round water not previously present. This has greatly improved fishing opportunities in the region, and the rivers are heavily used by villagers. The building of dams has proved highly successful in terms of meeting the needs of local people, and in increasing available water resources for wildlife.

It is, at this point, still unknown whether Nazinga can function as an operating game ranch. There is very little data on West African carrying capacities and wildlife. Censuses, conducted since 1981, indicated that oribi (*ourebia, ourebi*), warthog and Grimm's duiker (*Sylvicapra grimmia*)

populations have significantly increased in the last three years--there is not enough data to draw conclusions for the other species. There are several factors working against the establishment of a successful game ranch at Nazinga--potential densities are unknown but presumably less than East African densities at which most game ranching is conducted, the harvesting of animals will be made quite difficult due to the rough terrain, thick vegetation, shy nature of the wildlife, the size of the market and the people's ability to pay for any meat produced is also largely unknown. Whether or not the project does become an operating game ranch though, it has great value as a first step towards reinstituting a system of legal utilization of wildlife in the country, and suggesting ways in which park management might be integrated with consumptive uses as well. Such projects may well solve many of the public relations problems often associated with conservation areas.

CHAPTER 41

BURUNDI: PEACE CORPS

BURUNDI WILDLIFE/PARKS PROJECTS

BY

PETER TRENCHARD

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1. COUNTRY STATISTICS:

Population: 4,500,000 - 45% male, 55% female

Surface Area: 27,834 km^2

Average Population Density: 162 people/km^2

Maximum Population Density: 350 people/km^2

Capital: Bujumbura located 3°20' South latitude, 775 m. altitude

Average Maximum Temperature: 23.6°C.

Average Minimum Temperature: 14.4°C.

Highland Elevation: 1200-2500 m.

Rainfall: 700-2,000 mm.

Principle Cash Export Crops: coffee, cotton and tea

Per Capita Income: 180 dollars

Burundi is a very mountainous country of volcanic origins, once almost entirely covered by forest. Today, only about three percent of the country's land is forested. The existing montane forest is both important for protection of watershed erosion and unfortunately, for wood. Burundi is the second most densely populated country in Africa, and as it's population mass increases, the remaining forested areas are decreasing rapidly.

Burundi, bordering on Lake Tanganyika, contains the southern-most section of the rift mountains that make up the Zaire-Nile divide. Along the divide are the remains of the forest that once connected with the forests throughout the divide in Zaire, Uganda and Rwanda. Being at the southern most terminus of the divide, there exists a unique mixture of animals from different ecosystems, especially at the Bururi Forest Reserve.

To create a park reserve system, the government formed the National Institute for Nature Conservation (INCN) which would be responsible for the protection of the country's natural areas. The following nine areas are currently under INCN's jurisdiction.

2. RUMONGE FOREST NATURAL RESERVE--400 Ha:

This forest of *Brachystegia* constitutes evidence of the extension from the northern forests and the Zambian flora to the south.

Cercopithecus and several species of duikers are found in the forest. Much bird life is present due to the proximity of Lake Tanganyika.

The forest is a reserve to protect local slopes from eroding, to regularize river outlets and to permit good irrigation for local

agriculture projects. Lastly, the reserve was created for scientific research and the need to maintain natural processes in a nondisturbed state for scientific ends and to "maintain genetic resources in a natural state of evolution."

3. KIGWENA FOREST NATURAL RESERVE--360 Ha:

The Kigwena Forest was installed in 1954. Primates (*Cercopithecus* and *Cynocephales*) are present. The Nyengwe River within the forest also contains the rare aquatic civette.

The main reason given to protect this area is to protect an interesting natural area towards scientific ends.

4. RWIHINDA LAKE NATURAL RESERVE--425 Ha:

This reserve was installed in the year 1959. The lake is characterized by floating islands of peat and peat swamps. Bird Lake, as it is called, has a large population of migratory and native birds, especially the larger water birds. The lake has crocodiles, hippos and an abundance of fish.

The reserve was created for scientific ends and also for recreational and educational purposes. The objective for this park is for it's preservation and, if possible, the management of the quality and quantity of the fish and bird populations. Controlled tourism will be organized in this region.

5. RUZIZI NATURAL RESERVE--5,234 Ha:

This reserve is held in high importance for the development of tourism, especially for Bujumbura, since it lies on the outskirts of the capital.

The government recognizes that the majority of the tourists leave Bujumbura without having the occasion to see the animals. And they realize that most of the tourism throughout Africa is based on seeing exotic landscapes and the animals in their natural environment.

This reserve has the advantage of being close to the capital where there are good hotels and ways of getting out to see the park. In this park, one can see hippos, crocodiles and many species of migratory birds easily. Also, buffalo and small antelopes can be seen. This park does not have the number or variety of animals that can often be seen easier in other countries. As a result, this park cannot be expected to attract tourists, but it may provide a small income from the people who live in Bujumbura or an opportunity for the tourist who cannot make it into the interior.

At one time this plain held some of the largest herds of wildlife in Africa. It was lost to poaching, bad fire management, destructive herding and agricultural practices.

The government understands the lack of fauna as an attraction and is pushing the natural palm forest of *Hyphaene benguellensis*, as one of the main reasons for its protection for scientific and touristic purposes, as well as the plains' abundant bird life. It is hoped that the existing animals will be able to flourish without harassment and possibly provide another attraction.

6.   BURURI FOREST NATURAL RESERVE--1,500 Ha:

The Bururi Reserve was created in 1951 and is a remarkable relic of montane forest, as it consists of many species rarely seen together or in this sort of ecosystem.

The forest consists of Strombosia, Entrandophragma and other large forest species. It has six species of primates: red-tailed, blue and green monkeys, baboons, chimpanzees and galagos.

The forest is currently being protected by a Peace Corps/USAID project that is planting plantations around the forest for protection. Peace Corps is also going to continue this protection effort by introducing an agroforestry program to get people to rely on the forest for wood products less readily. The forest is in one of the more densely populated areas and the need for wood is great. Although the forest is small, it does have great possibilities scientifically as it is a unique montane forest with unique combinations of species. Also, because of its size and close proximity to Bujumbura, it would be easy for people to observe the chimpanzees.

The legislation for the reserve states that it is to protect the forest in a nondisturbed state for scientific ends and for protection of the watershed and against erosion.

7.   GERMAN CLIFF NATURAL MONUMENT OF NYAKAZU--15 Ha:

The German Cliff is formed by a deep ravine occupied by a gallery forest of *Entrandophragma* in an exceptional geographic situation. This small area of 15 hectares was created for the appreciation of the public, for tourists and for geographical research.

8.   KARERA WATERFALLS NATURAL MONUMENT--20 Ha:

The falls of the Karera River is considered to be of great touristic interest because of its natural beauty. It is located very close to the German Cliff Monument. Its gallery forest and surrounding forest is rich in flora insufficiently studied. It is held by the INCN for its touristic importance, for the protection of a natural area, for the education and for the public appreciation.

9.   RUVUBU NATIONAL PARK--43,630 Ha:

The Ruvubu National Park is the largest of the two parks in the country. It is in the eastern part of the country and borders to the north with Tanzania. It is a new park that saw the last of the people displaced in the spring of 1984.

The numbers and diversity of the species to be found in the Ruvubu area does not compete with the larger and more diversified parks in East Africa. As such, it would normally be easier for tourists to visit areas where the herds are more abundant and more accessible.

The government is hoping that by protecting the park it will enable the animals to flourish and their numbers will be increased by animals coming from Tanzania. This will take considerable time, meanwhile, they are going to focus their attention on inventorying the flora and fauna of the park. The area has not been studied and there are conflicting reports of what kinds of wildlife still can be found there.

10. KIBIRA NATIONAL PARK--37,670 Ha:

This park was originated in 1934 by the Belgians. It had, and still does have, total protection. However, little biological survey work has been done and, until recently, little effort to protect the forest has been made. In 1978, the French started a forestry project at Kibira which has to date worked tremendously well. More than 15,000 hectares of *Pinus patula*, eucalyptus and other exotics have already been planted as a buffer around the park. This buffer zone is not for production but for the sole purpose of protecting the forest. The government also has a cadre of 28 guards that regularly patrol the forest. This project adequately protects the forest but does not include in its objectives the inventory of plants and animals or the investigation of the park's touristic value.

In 1983, Weber and Vedder did a three month study sponsored by USAID in the forest and Bururi. In their report, they had recommended that the Peace Corps place a biologist in that forest to study the touristic potential of the forest and to do a more in-depth survey of the animal and plant populations. At the same time, the INCN asked Peace Corps to place a Volunteer in their parks program, and a Volunteer was placed in Kibira, which was deemed to have the most potential for tourism as well as scientifically.

The Kibira Wildlife Project is of three years duration with the objective of studying the ecology of the chimpanzee population and inventorying the animal and plant species in the Kibira National Park. It will determine the numbers, movements, diet and reproductive status of this population of chimpanzees, estimated at 200-300. The site is well-protected and maintained by an existing forestry project. Such a study would be an invaluable tool in the development of a chimpanzee reserve. The data received will serve as a basis on which the Burundi government can act to make further plans for the park.

The forest is located in the northwestern section of the country and stretches from the border of Rwanda to its southern terminus in the small 1,500 hectare Bururi Reserve. It is divided into four forest massifs, Kibira National Park being divided up into three sections and the fourth comprising the Bururi Reserve.

Kibira National Park is about 38,000 hectares of which around 23,000 hectares are virgin montane forest. The park follows the mountain range that constitutes the Zaire-Nile divide and is from one to four kilometers

in width and about 150 kilometers (by road) to the border of Rwanda. The altitude is between 1,500 and 2,660 m. It is known to contain several thriving families of chimpanzees, as well as red-tailed monkeys, vervets, blue monkeys, baboons, galagos, forest pigs, leopards and several endangered plant species such as *Entrandrophragma excelsum* and the wild banana.

The history of conservation in Burundi is not the best. It is necessary though, to give it a chance to improve its world image on conservation issues by supporting its efforts. The INCN is very serious about conserving its parks as is illustrated by the rapid progress of its forestry project which maintains and protects the site.

After the initial survey is finished, the INCN will be able to complete an overall plan for the park. If the current project proves to be feasible, plans will be made to develop the park as a tourist attraction and/or research center. It is hoped that research will continue to be a priority and be able to continue throughout the development of the park, as it could prove an interesting comparison between other chimpanzee populations studied in East Africa.

Educational aspects of the park will be developed after the initial phase. Extension work will be considered a main objective of the project to fully insure the protection of the forest. In the future, this program may include, not only extension, but educational facilities at the park itself.

The Kibira Forest is practically the only remaining tropical highland forest left in Burundi and indeed, this type of forest is rare in the world. The forest has to be protected from the harvesting of fuel and lumber wood by the surrounding population, and its local animal population needs to be studied and protected from hunting. It is important to protect this montane forest to prevent further erosion in the surrounding hills and to conserve its important role as a natural watershed area. It is towards these ends that the government has created the INCN and this park.

11. OBJECTIVES OF THE KIBIRA WILDLIFE PROJECT:

a. Research for the protection and possible rehabilitation of the chimpanzees include:

(i) Numbers and sex/age information of the chimp population.

(ii) Distribution and territorial information.

(iii) Daily and seasonal movements.

(iv) Detailed dietary survey, including which species are eaten, the portion of the plant used, when they are eaten and any other food sources like insects, other mammals, etc.

(v) Approximate percentage distribution of the major food species in the park.

b. Evaluation of the touristic potential and guidelines for its development.

c. Determination of the carrying capacity of the park to see if relocation or reintroduction is feasible or necessary.

d. Inventories of the mammalian, bird, insect and plant populations of the park.

e. Determine sites which may be used to construct a center for tourists and visitors.

f. Determine the placement of paths for visitors and for surveillance.

g. Teach the forest guards basic skills on their level.

h. Establish a program of conservation education for the surrounding population.

BURUNDI

INSTITUT NATIONAL POUR LA
CONSERVATION DE LA NATURE
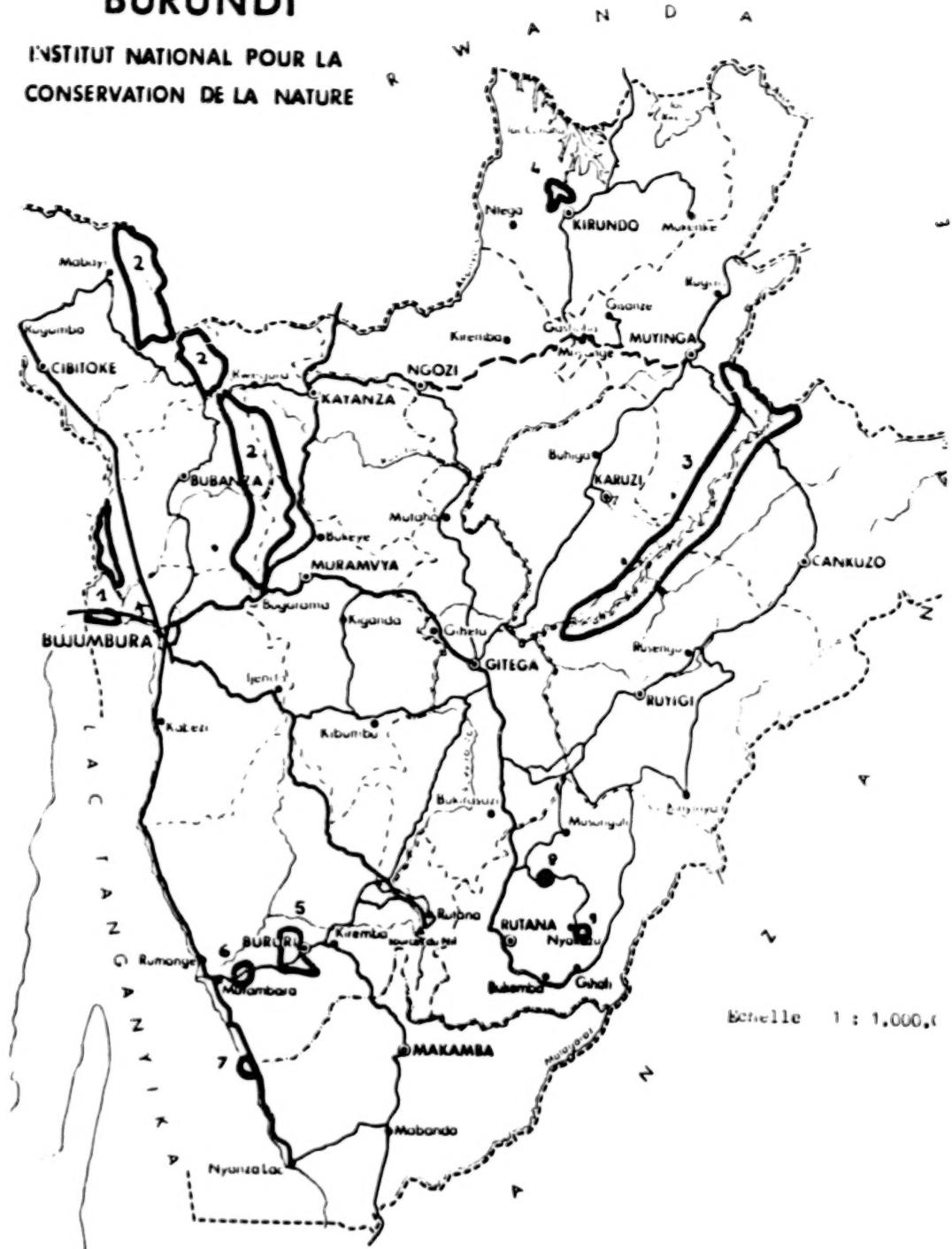
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Domaine géré par l'I.N.C.N.

1 - Res. Nat. gérée de la RUZIZI
2 - P.N. KIBIRA
3 - P.N. RUVUBU
4 - Res. Nat. gérée Lac RWIHINDA
5 - Res. Nat. For. BURURI

6 - Res. Nat. For. D'ENGE
7 - Res. Nat. For. RIGWEMA
8 - Monument Nat - Chutes KARERA
9 -   "   "   - Faille des Allemands

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CHAPTER 42

MALAWI: PEACE CORPS

MALAWI WILDLIFE/PARKS PROJECTS

1. INTRODUCTION:

Malawi is a small country with a land area of 95,000 km^2. The population is over six million people, making it the fifth most densely populated country in Africa. However, a total of 10,797 km^2 or 11.4% of the land area is designated as national park and game reserve, and a further 5% is designated as forest reserve.

The national parks and game reserves are administered by the Department of National Parks and Wildlife, which became an autonomous department in 1973, having previously been combined with the Departments of Fisheries, Tsetse Control and Forestry. The department currently falls under the Ministry of Forestry and Natural Resources.

The Department of National Parks and Wildlife has an establishment of about 240 staff members plus nonestablished staff and a recurrent budget of about US $500,000 p.a. of which about one-third is recovered from revenue, the largest component of which is the sale of ivory. The balance is made up from government subvention.

The department consists of a headquarters unit based in the capital, Lilongwe, and three regional management units corresponding to three administrative regions of the country, Northern, Central and Southern. It also contains a wildlife research unit, an education and information Unit and a mechanical unit. A formerly separate wildlife control unit has now been absorbed under the regional units.

The majority of large wild animals are confined to the protected areas although significant populations of hippo and crocodile occur outside these areas, particularly in Lake Malawi, the Shire River and the Elephant Marsh. However, there is no significant wildlife management effort outside the protected areas other than wildlife control.

The details of the wildlife management program are given in the master plan for National Parks and Wildlife Management (Clarke 1983, a, b, c and d), and the Tourism Master Plan (Carter 1985). Statistics of the protected areas are summarized in Table 1 and are shown in Figure 1.

TABLE 1

THE NATIONAL PARKS AND GAME RESERVES OF MALAWI

(FROM CLARKE 1983)

Category	Name	Area (km^2)	Date of achievement of present status
National Park	Nyika	3,134	1978
	Kasungu	2,136	1970
	Lake Malawi	94	1980
	Liwonde	548	1977
	Lengwe	887	1975
	TOTAL NATIONAL PARKS	6,979	
Game Reserve	Vwaza Marsh	986	1977
	Nkhotakota	1,802	1970
	Majete	690	1976
	Mwabvi	340	1975
	TOTAL GAME RESERVES	3,818	
	TOTAL PROTECTED AREAS	10,797	

2. NORTHERN REGION:

The department headquarters for Northern Region is located at Thazima at the entrance to Nyika National Park. The region contains two protected areas, Nyika National Park and Vwaza Marsh Game Reserve, plus a wildlife control office at the regional capital, Mzuzu.

a. Nyika National Park:

This is Malawi's largest protected area, reaching its present size of 3,134 km^2 as a result of extensions in 1978. The park consists of hills and high plateau, the central part being occupied by the Nyika Plateau, an area of about 800 km^2 of rolling montane grassland with many small montane and submontane forest patches, between 1,600 m and 2,600 m a.s.l. The rest of the park consists of broken foothills, steep escarpments and large faulted valleys covered by upland *Brachystegia* woodland with forest patches on the wetter eastern slopes. The climate of the park is cool and moist, rainfall varying between about 1,200 mm and 1,600 mm p.a. The plateau holds a dense population of reedbuck, as well as eland, roan, zebra, warthog, bushpig and duiker. The forest patches contain blue monkey, blue and red duiker and leopard. The grasslands and forests contain a number of rare and endemic species and subspecies of mammals, birds, insects and plants. The wooded hills contain low densities of the typical miombo fauna, including a small population of elephant in the northern valleys. The plateau is fairly well-developed with a network of roads and a small self-catering tourist camp at Chilinda in the center. The wooded hills are inaccessible and undeveloped. The primary management problem concerns the balance between the three main habitat types, woodland, grassland and forest; a system of controlled burning has been maintained since the early 1970s. The Nyika is an area of exceptional scenic beauty and biological interest, and has been proposed as a World Heritage Site.

b. Vwaza Marsh Game Reserve:

This reserve of 986 km^2 was gazetted in 1977; it lies on the central African plateau on the eastern lip of the Luangwa rift at about 1,000 m a.s.l. The eastern half of the reserve consists of the wooded foothills of the Nyika massif, the western half of alluvial marshes, clay flats with mopane and plateau *Brachystegia* woodland. Rainfall is around 1,000 mm p.a. The reserve contains elephants, hippos, buffalo, roans, sables, hartebeests, zebras, elands, impalas, kudus and small game, as well as lions and leopards. Populations are increasing following the removal of settlement in 1977-78. Illegal activity is still prevalent and constitutes the principal management problem of the reserve. The reserve is undeveloped with a few dry season tracks and a small tended camp for visitors. Peace Corps Volunteer Tom McShane has acted as Research Officer for the reserve since 1982.

3. CENTRAL REGION:

The department headquarters for Central Region is located in Lilongwe and includes a crop protection facility for the region, which also contains two protected areas, Kasungu National Park and Nkhotakota Game Reserve.

a.   **Kasungu National Park:**

The park covers 2,316 km^2; it was originally cleared of settlement and gazetted as a forest reserve in 1922 on account of sleeping sickness and became a national park in 1970.   The park consists of typical gently undulating plateau *Brachystegia* woodland on sandy soils with a well-developed dambo drainage system.   The altitude is around 1,000 m a.s.l. and rainfall around 800 mm p.a.   The fauna is typical of the central African plateau, being of generally low densities, but including Malawi's largest elephant population (around 800), buffalo, a few black rhino, sable, roan, hartebeest, eland, kudu, etc., plus the major predators.   Kasungu is Malawi's most developed protected area with a tourist road network and a fully catering tourist lodge.   The primary management problem has been illegal activity which rose to a peak in 1981 but is now relatively well under control.   Crop damage on the boundaries has been reduced by electrified fencing.   The coppicing of *Brachystegia* woodland by elephant is being monitored.

b.   **Nkhotakota Game Reserve:**

This reserve of 1,802 km^2 reached its present size in 1970.   The reserve is scenically spectacular, being situated on the rift escarpment of Lake Malawi, descending from a high point of 1,600 m to the lakeshore plain at 520 m.   The topography is rugged, consisting by a large number of steep faults and faulted valleys, and traversed by many perennial rivers and streams, the largest of which is the Bua.   The vegetation consists mainly of escarpment *Brachystegia* woodland with riverine forest strips along several rivers and a patch of submontane forest on Chipata mountain.   The area contains the typical miombo fauna, although at low densities.   The reserve is undeveloped with limited access and no tourist accommodation. The primary management problem is illegal activity.

4.   **SOUTHERN REGION:**

The departmental headquarters for Southern Region is located at Limbe, the sister city of Blantyre, the country's commercial capital.   The region contains five protected areas and a crop protection facility.

a.   **Lake Malawi National Park:**

This park, created in 1980, is Malawi's most recently acquired protected area.   The park covers 94 km^2 and consists of the Cape McClear peninsula at the southern end of Lake Malawi, several adjacent islands, and a 100 m strip of water surrounding these land areas.   The principal object of the park is to preserve a sample of the spectacular fish fauna of Lake Malawi, which contains over 500 species, most of them endemic.   The park is also intended to conserve the woodlands and fauna of the rocky peninsula and islands to integrate with the land use of the surrounding human population and to coordinate tourist developments in this prime recreational area.   So far, however, the park is relatively undeveloped and contains only a small tourist camp.   The principal problems of this park are integrating with the surrounding communities, and a system of graded utilization by zone is being built up.

b.   Liwonde National Park:

The park covers an area of 548 km^2 on the floor of the rift valley at about 500 m a.s.l. alongside the Shire River from its exit from Lake Malombe. The rainfall is about 800 mm p.a. The park consists of fertile clay flats and alluvial banks and is covered by mopane and mixed fine-leaved woodlands, thickets and riverine forests with extensive marshes and floodplains near the Shire. As such, the park has a high carrying capacity for wildlife including hippos and crocodiles, although several species such as buffalo, rhino, eland and zebra were exterminated earlier in the century and need to be replaced. The park is being developed for tourism for which the potential is high because of its convenient location, attractive scenery and good game viewing. Currently, it has a small self-catering camp. The primary problem of this park is the developing elephant problem due to concentration of elephants along the Shire frontage in the dry season.

c.   Majete Game Reserve:

This reserve occupies 690 km^2 of broken country in the rift valley floor at the point where the middle Shire Valley descends from about 500 m a.s.l. to about 100 m a.s.l. in the lower Shire Valley. The climate is hot and relatively arid by Malawi standards, rainfall ranging from about 600 mm-800 mm p.a. The western half of the reserve consists of rugged hills with lowland *Brachystegia* woodland; the eastern half slopes towards the Shire river, consisting mainly of open *Combretum-Terminalia-Sclerocarya* parkland dissected by many sand rivers. The reserve has a 20 km frontage on the Shire, as far as the spectacular Kapichila Falls. The fauna is sparse, with a small population of elephant as well as kudu, waterbuck, sable, warthog, etc. The reserve is undeveloped with limited access and tourist accommodation, although the potential is high because of its attractive scenery and proximity to the urban areas. The primary problems are shortage of water and edible forage in the dry season, exaggerated by illegal activity.

d.   Lengwe National Park:

The park is situated in the lower Shire Valley at about 100 m a.s.l. The climate is extremely hot and relatively arid, with rainfall at about 600 mm p.a. Lengwe consists of two distinct sections. "Old" Lengwe covers 104 km^2 of fertile alluvium on the rift valley floor of the lower Shire Valley, and supports a high quality vegetation of thicket and *Acacia* savanna and a high density of wildlife. Established in 1964, this part of the park was developed in the late 1960s by installing four artificial waterholes in a previously waterless area. This was followed by a population explosion of nyala, now being held at about 2,000. The much larger extension to Lengwe (783 km^2) was added in 1975; this covers a section of the western escarpment of the lower Shire rift and consists largely of sandstone outcrops with narrow alluvial valleys, a mixed vegetation and low wildlife densities. "Old" Lengwe is well-developed with a road network and self-catering tourist chalets, as well as viewing hides at the waterholes. The extension is undeveloped and inaccessible. Apart from the population explosions in "old" Lengwe, the main problems are

illegal activity and encroachment by the dense surrounding human population.

e.   **Mwabvi Game Reserve**:

This reserve covers an area of 340 km^2 of the western escarpment of the lower Shire Valley. The climate is similar to that of Lengwe, i.e., extremely hot and relatively arid. The topography is broken and rocky, with extensive sandstone, dolerite and basalt outcrops and small alluvial valleys. The vegetation is a mixture of dense deciduous thicket, fine-leaved woodland and mopane. The reserve contains a mixed fauna including a small population of black rhino. The reserve has limited access and tourist accommodation. The primary problems are very limited dry season water exaggerated by illegal activity and encroachment.

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MALAWI :   NATIONAL PARKS AND GAME RESERVES
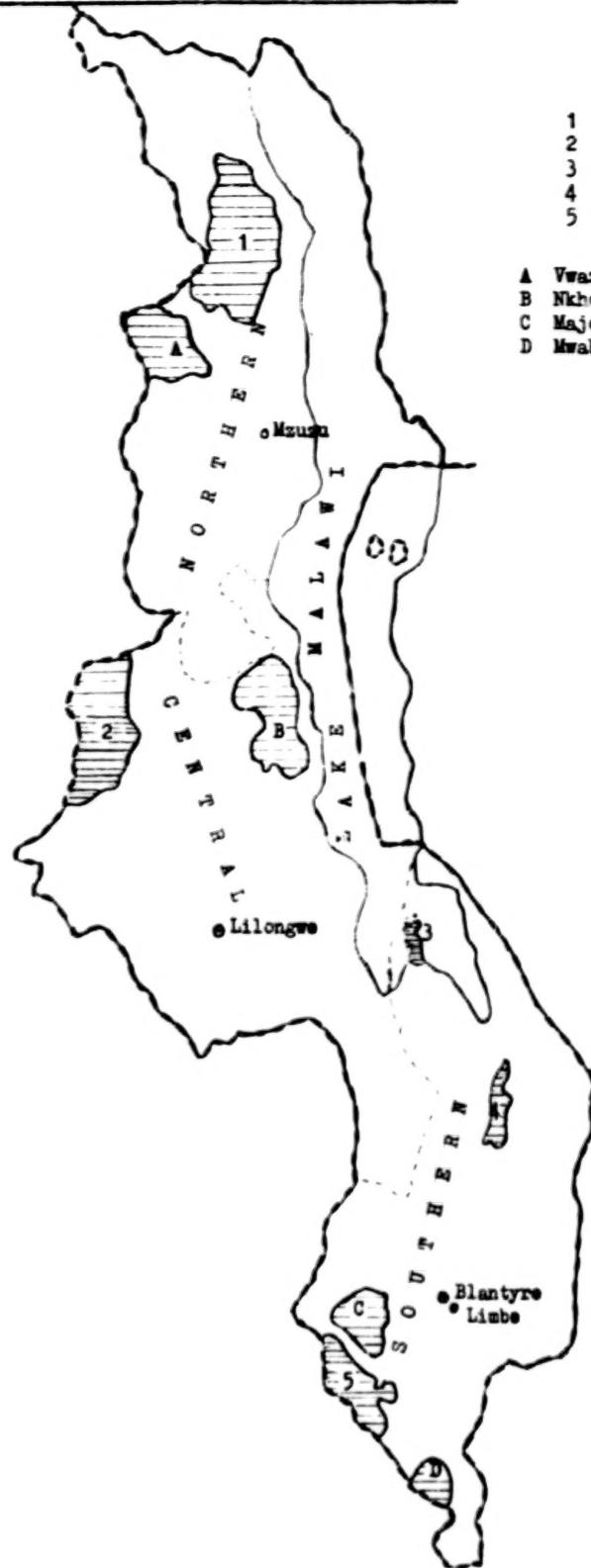
1   Nyika National Park
2   Kasungu National Park
3   Lake Malawi Nationl Park
4   Liwonde National Park
5   Lengwe National Park

A   Vwaza Marsh Game Reserve
B   Nkhotakota Game Reserve
C   Majete Game Reserve
D   Mwabvi Game Reserve

CHAPTER 43

SWAZILAND: PEACE CORPS

SWAZILAND ENVIRONMENTAL EDUCATION/PARKS PROJECTS

BY

ISIAIH CINDZI & SUZY ELLIS
NATIONAL ENVIRONMENTAL EDUCATION PROGRAM

Swaziland has five main nature reserves. These have been established in each of the geographical regions of Swaziland to assure protection of represented unique habitats.

These reserves are as follows:

a.   **Malolotja:**   Highveld geographical region

18,175 Ha

Malolotja Falls--highest falls in Swaziland

b.   **Mlilwane:**   Middleveld geographical region

4,500 Ha

First nature reserve in Swaziland and greatest variety of animals

Important staging point for migratory birds

c.   **Hlane:**   Lowveld geographical region

16,275 Ha

Supports endangered Cape vulture

Densest population of wild ungulates historically recorded in Swaziland

d.   **Mlawula/ Ndzindzi:**   Lobombo plateau geographical region
24,000 Ha

Site for naturally occurring cycads

Contains sites of historical and archeological significance

(REFER TO MAP FOR LOCATIONS OF RESERVES)

1.   GEOLOGY OF SWAZILAND:

Much of Swaziland's soil is of a granite parent rock. In the highveld, where leaching occurs annually during the rainy season, the grass is of a sourveld quality. The elevation here is 615-1,800 meters and the yearly rainfall is 1,525 mm.

Location of Nature Reserves

Malolotja 1
Mliluwne 2
Hlane 3
Mlauula/Ndzindza 4

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In the middleveld the grass quality is mixed; both sweet and sour grasses are found. The annual rainfall is 1,270 mm and the elevation is 660-1,437 m.

In the lowveld we find our best grazing grasses which maintain a sweet quality year round. Here, the parent rock is mainly basalt with no leaching occurring. The elevation is 210-330 m and the rainfall is 890 mm.

The Lobombo plateau is of a resistant rhyolite rock. The plateau was formed by the eroding of the basalt on either side of it. The elevation is 120-565 m and the annual rainfall is 750 mm. It is mainly a savanna veldtype and the grass is of a mixed quality.

2. SLIDE PRESENTATION:

The Swaziland National Environmental Education Program was started in 1975. The slide presentation summarizes the components of the program. It takes you through a guided tour of the interpretation center, rest camp area and game viewing. You will participate in an outreach outing, capture aquatic life on a water study and put together the skeleton of python and a young rhino.

3. FILM--"THE CUSTODIANS":

The film describes the work of the National Trust Commission and the governing body of all conservation work in Swaziland. A primary concern is the preservation of Swaziland's heritage. The Commission is responsible for the national museum, sacred burial grounds, the Swaziland Archeological Research Association and the running of the reserves in Swaziland. An action section reviews game capture with a helicopter and the film closes with the late King Sobhuza I who was a great champion of conservation.

SLIDE SHOW PRESENTATION:

SWAZILAND NATIONAL ENVIRONMENTAL EDUCATION PROGRAM

The importance of interpretation is just now being realized in this part of the world. In the past, game rangers had very little, if any, personal contact with the general public. Now with increasing populations (said to be the greatest in the world), interpretation and environmental education are seen as a necessity if protected lands are going to survive in this country (Swaziland) as well as neighboring countries.

Swaziland's National Environmental Education Program (NEEP) is the only program of its kind in the country. It is based at Mlilwane Wildlife Sanctuary and directed by Mr. T.E. Reilly who founded it and initial conservation efforts in the Kingdom. It aims to create environmental literacy and awareness among all people of Swaziland in an effort to ensure conservation of the Kingdom's natural resources.

1. At Mlilwane, an interpretation center is the main teaching site for thousands of school children that visit the reserve annually for an educational tour.

2. The buses arrive and proper introductions are made.

3. The students are given an explanation of what the tour will involve and then are asked a few questions: why are they visiting Mlilwane?

4. What do they expect to see? Why protect certain areas in Swaziland? Should we protect animals? What is conservation? And so forth.

5. This starts to excite them and as they walk with their education officer the questions start to flow. Are we really going to see a hippo? Will the crocodile eat me? Where's the toilet? You must be ready for all sorts of questions.

6. A number of animals are residents of Mlilwane rest camp and as the opportunity lends itself the education officer will interpret to the students specific details about the animals. For instance:

7. This is Crook and his mate or wife. They are blue cranes and they lay eggs every year. They nest on the ground and hatch their eggs in the summer time.

8. This is budzaketane or warthog. The warthog's home is a burrow or hole in the ground where they sleep at night. For defense they back into their burrow with their tusks facing any enemy that may try to dig them out.

9. The snare display usually produces a few oohs and ahs. Many can hardly believe the number of snares or that poaching is still prevalent.

10. The officer will demonstrate and explain how the snare is set. He explains how animals die in these snares when they are not checked.

11. The tour then moves on to the bird pool. Students get their first introduction to ecology and ecosystems.

12. They learn that an ecosystem is a part of the biosphere in which we live. The interactions and relationships between living and non-living elements.

13. They learn of the community of hippos,

14. Of warthogs,

15. Of birds, reptiles, fish, and etc.

16. They learn how the different communities of birds, hippos, warthogs and

17. Etc., live together in their breeding populations in a particular ecosystem.

18. Next stop is the interpretation center itself. In the half daval students will view and learn about the spoor of various animals,

19. As well as skull and skeleton structure.

20. A full scale mural of Swaziland in cross-section provides

21. The students with a chance to compare the differences between

22. Elevation, rainfall, temperature, and vegetation of the four geographical regions.

23. A quiz on animal skull identification helps the student to learn the differences between a herbivore and a carnivore and which animals still exist in Swaziland.

24. In the conservation hall the students will view a film

25. On conservation in Swaziland or a neighboring country.

26. A game viewing tour gives the students a chance to see the indigenous wildlife which is so much a part of their heritage. The education officer has an opportunity to explain something about animal psychology and behavior.

Our interpretation center consists of two parts. The conservation hall which houses various wall displays. The hall is used to show slides and movies as well as for lectures. Maximum floor space had to be achieved in order to hold the great number of school children visiting from a single school.

a. Displays include topics such as the nature reserves of Swaziland, where they are located and why in these particular areas;

b. A display of a food chain helps to give a clearer picture of energy flow;

c. Swaziland's population is doubling in 20 years and at this rate the land presently available for homesteads will be used by the year 1990; and

d. An important program is family life association. Spacing of children is first emphasized before the use of mechanical birth control methods.

The Second Part of the Center is an Open Half Daval:

a. Here is housed a display of animal spoor, dung, skulls and pictures of the animals which exist in Swaziland today as well as a few that are extinct because of traditional practices.

b. The mural of Swaziland in cross-section can be used in a number of ways. Protected lands can be indicated, soil formation starting with samples of the parent rock can be demonstrated, geographical regions, veld types, and grass quality can all be explained by using the mural.

c. Other displays include historical facts about Swaziland going back to the time when bushmen inhabited the country.

Orphaned Animals:

Orphaned animals play an important role at the interpretation center. Presently, we have a jackal buzzard name Buz. Brought to the reserve as a chick, she has not failed to excite and help educate a number of students teachers, and tourists. As a first hand example of a food chain, she is right-on-cue at catching and devouring her favorite meal, a skink or rat.

Volunteers:

a. We are fortunate sometimes to have volunteers who help out with new interpretive displays. Gus, here, is about to go crazy figuring out which is the proper direction or articulation for the ribs of this python skeleton.

b. This one year old white rhino will soon be initiating questions from inquisitive minds--how did it die? Was it killed by lions? Was it poached? How old was it? Was it born here? Where is its mother? Was it still drinking milk?

The need for interpretation and education in developing countries is urgent. Much of the existing interpretation has a negative foundation. "If you do not take care of this problem now, this is going to happen." Fortunately, in Swaziland, there are ongoing projects that are slowly and successfully alleviating some of these problems. Positive interpretation can give only positive results.

CHAPTER 44

LESOTHO: PEACE CORPS

LESOTHO NATIONAL PARK PROJECT

1.   COUNTRY OVERVIEW:

Lesotho is a small country (30,300 km^2) completely surrounded by the Republic of South Africa.   The Caledon (Mohokare) River forms the western border while the Drakensberg mountain range forms the eastern border. Lesotho, often referred to as the Switzerland of Africa because of its scenery and physical characteristics, has the distinction of being the only country in the world with its entire altitude more than 1,000 meters above sea level.   The current population of Lesotho is estimated at approximately 1.4 million.

2.   SEHLABATHEBE NATIONAL PARK:

Sehlabathebe National Park is Lesotho's only major protected area; other   much   smaller   areas   are   protected   under   the   Protection   and Preservation Commission of the Ministry of Education.   The 6,500 ha were set aside after a multidisciplinary team asked to access the feasibility of establishing a national park in Lesotho, and had preferred it to the Oxbow area because of its outstanding scenic beauty.   The area was declared a national   park   and   game   sanctuary   by   Legal   Notice   No: 34   of   1970. Livestock were removed from the area and World Wildlife Fund was approached for funds.   In 1972 World Wildlife Fund (WWF) provided funds to fence the 6,500 ha and to construct a double-story A-frame structure to be used as a field station.

3.   STAFFING:

a.   Once established problems arose; the most glaring was the lack of staff.   Lesotho started looking around for staff qualified in the running of national parks.   Requests were made to the United States Peace Corps (USPC) Service and the first Volunteer Parks Administrator arrived in Lesotho in 1974.   In 1975, he was joined by three more.   One to take over the administration from him while the other two were botanists.

b.   There have been nine more Volunteers since then.   Most were naturalists, and, together with the wildlife biologist they produced a brochure and two booklets--one a mammal guide, the other a flower guide.

4.   GEOLOGY:

a.   The park is an open, hilly grassveld situation between 7,200 and 8,500 ft. above sea level.   It contains the source and upper watershed of the Tsoelikana River.   Cave sandstone is the primary geological feature of the park.   In many areas the cave sandstone formations protrude through the shallow lithosol/sedimentary soil layer.   Wind and water erosion have created from these formations numerous arches, caves, and pools.   Red bed shale and basalt form part of the major geological feature.   A network of dolerite dykes is also found and one kimberlite dyke has been reported.

b. Topographical variations comprise a wide variety. Ponds and pools, marshes, rock overhangs, slopes and caves (with rock paintings). All these offer a varied habitat for Sehlabathebe's flora.

5. CLIMATE:

It is generally cool to cold throughout the year. Rainfall occurs mainly in summer with an average of 750 mm. Temperatures vary seasonally from a maximum of 30 degrees Celsius in summer to a minimum of -15 degrees Celsius in winter. Snow falls occasionally and melts relatively quickly. Mist comes frequently, engulfing the park and it can be quite disorientating. Strong winds are prevalent for most part of the year.

6. FAUNA:

Unlike many areas that are declared national parks, game reserves, etc., Sehlabathebe hardly had any wildlife except, maybe, for the smaller rodents. Wildlife had fled to the neighboring South Africa and some remote and inaccessible areas to avoid the wanton mass slaughter of game that characterized the turn of the century. In fact, most species are extinct in Lesotho, e.g., warthog, antbear. The mountain reedbuck appears to be restricted only to two districts. The fencing of Sehlabathebe National Park (1 km stretch is left to allow for seasonal migration into and from South Africa, Natal) and the resultant control of human activity has resulted in grey rhebuck population increasing from a dozen when the fence was erected to nearly 200 herd. Oribi, mongoose, otter, wildcat and black-backed jackal are now settled. Baboons and cape eland visit the park seasonably.

Bird life is abundant within the park. The most conspicuous species are the bald ibis, cape vulture, jackal buzzard, lammergeyer (the internationally protected bird that is endangered) and such migratory birds as the white stork, black-headed heron and yellow-billed duck.

The Tsoelikana River harbors a unique cyprinid fish, the *Oreodaimon quathlambae*--"The mountain spirit of the Drankensberg" when literally translated. This species was originally described by Barnard in 1938 from some specimen collected from the Umkomazana River, South Africa, but was subsequently lost to science, presumably, through siltation of the river and the overall degradation of its habitat. It was rediscovered in the Tsoelikana River in 1970. Detailed studies of this minnow still have to be carried out.

7. FLORA:

a. Due to topographical variations flora is quite unique and varied. Commonly encountered grasses belong to the genera *Themeda* (dominant), *Eragrostis*, *Agrostis*, *Pennisetum*, and *Pentascistis*.

b. There are also flowers like the orchids and lilies. Beneath the rock overhangs, in rock crevices, around cave mouths and seep holes one or more of the fern genera are found. *Polemannia montana* Schltr. and Wolf, *Buddlera sp* and *Printzia sp* are shrubs

that can be found on rocky slopes. Two unusual herbaceous species are found in the park; bladderwort, *Utricularia sp* and sundew, *Drosera sp* both of which are carnivorous.

c. The crown jewel of Sehlabathebe flora is the water lily *Aponogeton ranunculiforus*, Jacot Guillarmod and Marais a species unknown to science prior to 1970. Detailed studies of this flower still have to be carried out.

8. PROTECTION AND PRESERVATION:

a. The most important contribution made to the conservation of fauna and flora of Sehlabathebe National Park, and, indeed, it would seem of Lesotho as a whole, was the fencing of the park land during the years 1972-74. The fence has been effective in excluding domestic stock from grazing on park land and, thus, allowing many plant species to develop fully and set seed that would not have been able to do so under heavy grazing by domestic stock. The fencing-out of domestic stock has also allowed for some heavily eroded areas along the old animal tracks to become stabilized by pioneer plant species.

b. The national parks section is currently working on a fire management plan. This will prevent wildfires from sweeping through the park uncontrollably.

9. USPCV INVOLVEMENT:

a. Currently, there are two USPCV working in the park, one in fisheries and the other in wildlife.

b. Kelley Meyer, Fisheries Biologist, is working with the rare *Oreodaimon quathlambae*. He is conducting a census of where the cyprinid occurs within the Tsoelikana River.

Tim Donnay, Wildlife Ecologist, is engaged with the Cape vulture and lammergeyer. He will be mapping breeding colonies and determining reproductive status of these birds throughout Lesotho. Tim also works at Parks Administration to help with the updating of legislation which will make the proposed translocation of game feasible.

Lesotho map showing districts: BUTHA-BUTHE, LERIBE, BEREA, MOKHOTLONG, MASERU, THABA-TSEKA, MAFETENG, MOHALE'S HOEK, QACHA'S NEK, QUTHING, Schlabathebe National Park. Surrounded by South Africa.

END

04-22-91